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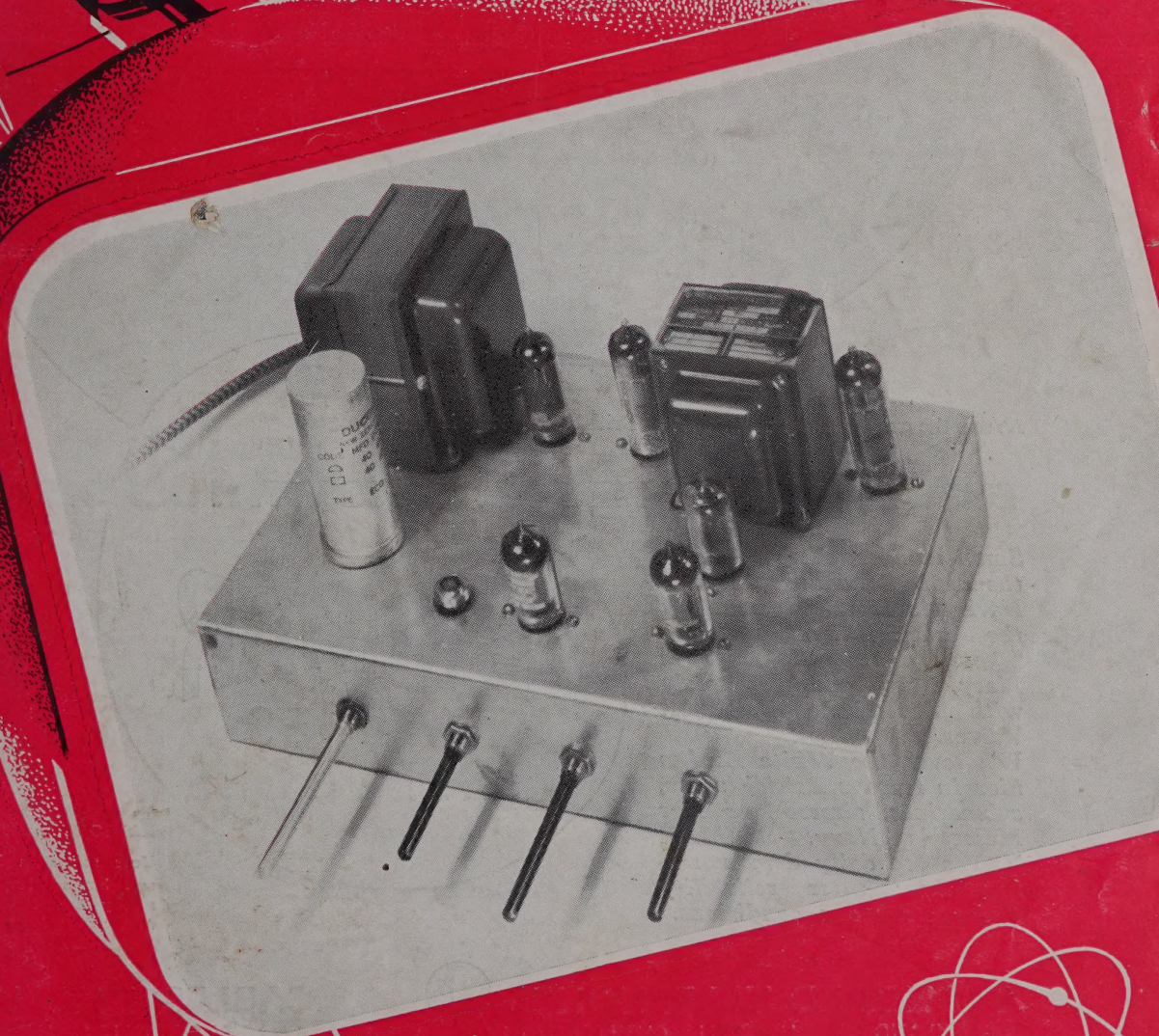

JUNE 1st, 1956

VOL. II, NO. 4

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Radio and Electrical Review

VOL. 11, No. 4 JUNE, 1st, 1956

OUR COVER PICTURE this month shows the top-chassis view of the "R. & E." 1956 Gramophone Amplifier—see article commencing on page 21.

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Contents

	Page
Editorial	20
A New "R. & E." Audio Lecture Course	20
Audio: The "R. & E." 1956 Gramophone Amplifier	21
A Novel Magic-eye Indicator Circuit	27
Philips Experimenter No. 104: Pulsed Operation of Transmitting Tubes	28
Amateur Topics: Neutralizing Circuits	30
Flight Crew Training by Electronics	33
Record Talk	34
Latest Overseas Developments	36
Commencement of Electrical and Trade Section	39
Bell and Alarm Systems	39
New Products	42
Trade Winds	44
For the Technician: Servicing Instructions for the H.M.V. Domestic Wringer Washer, Senior 35	47
N.Z.A.R.T. Notes	48
Notes from the N.Z. Electronics Institute Inc.	48

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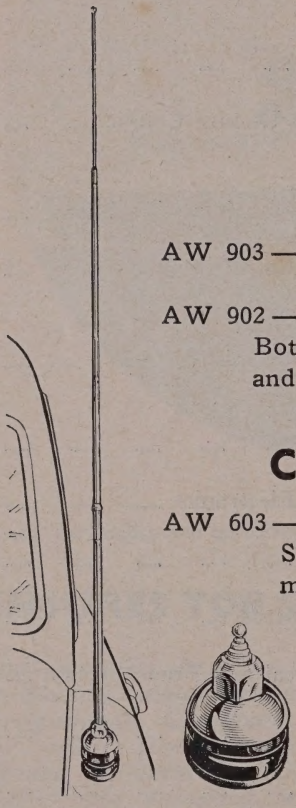

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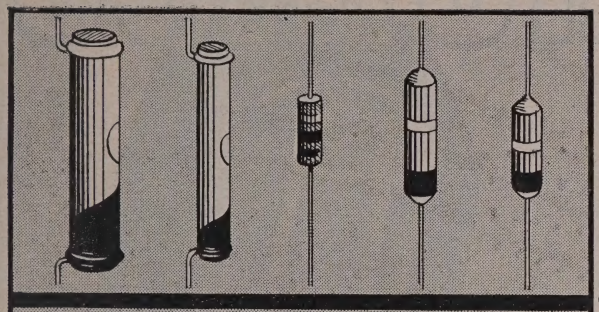

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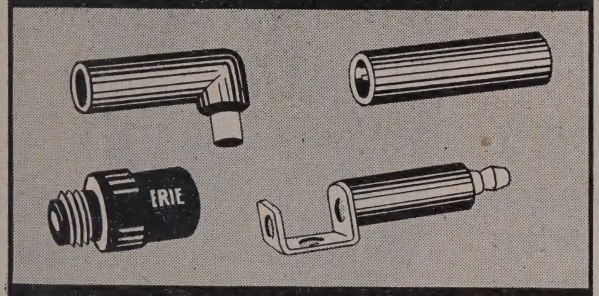

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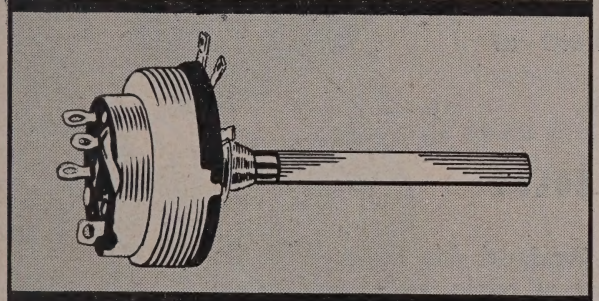

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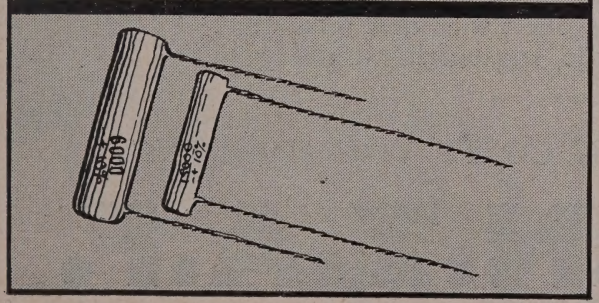

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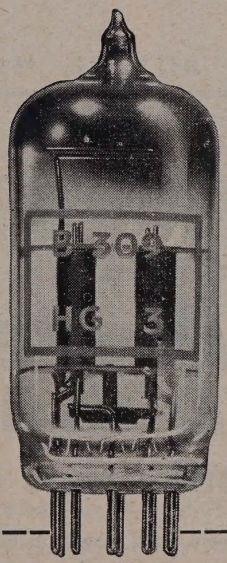

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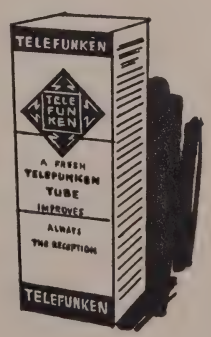

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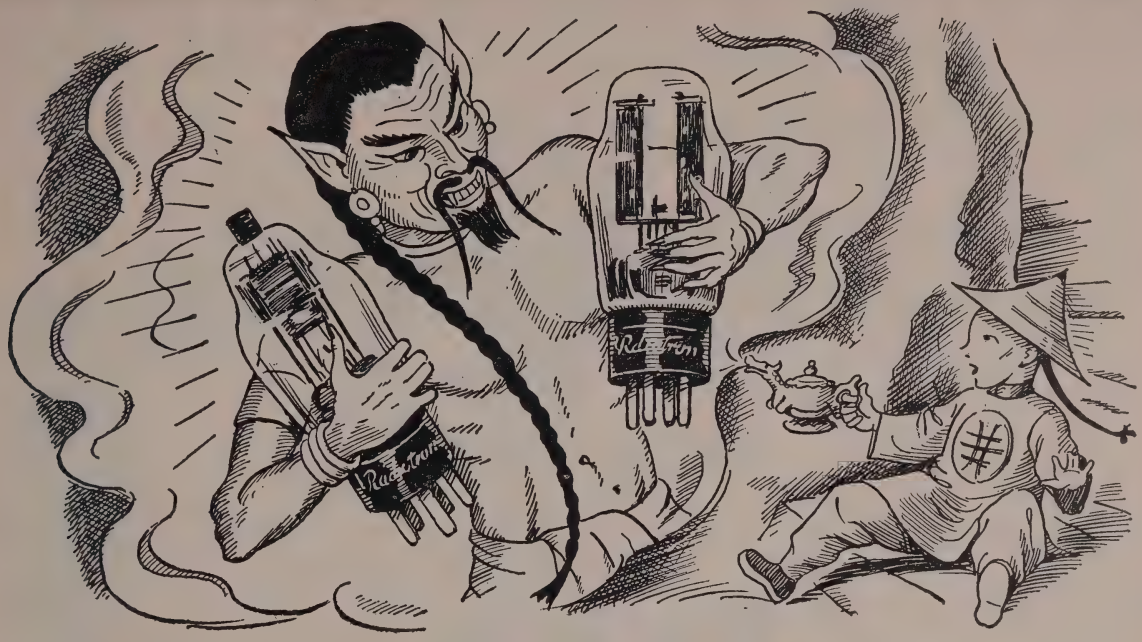

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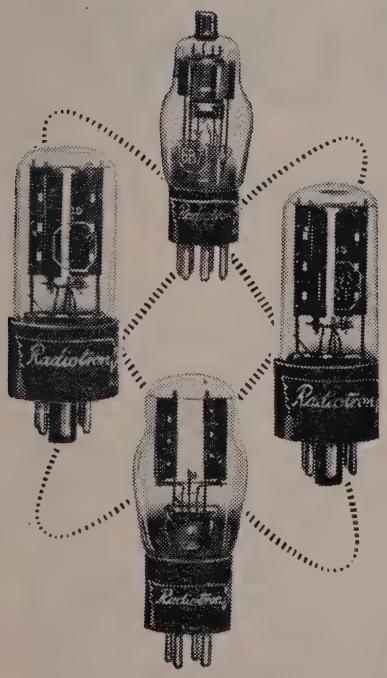

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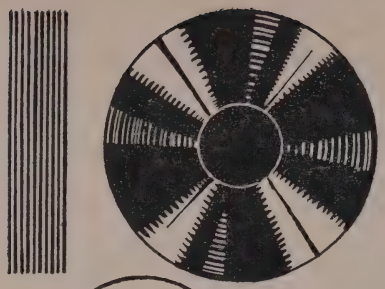

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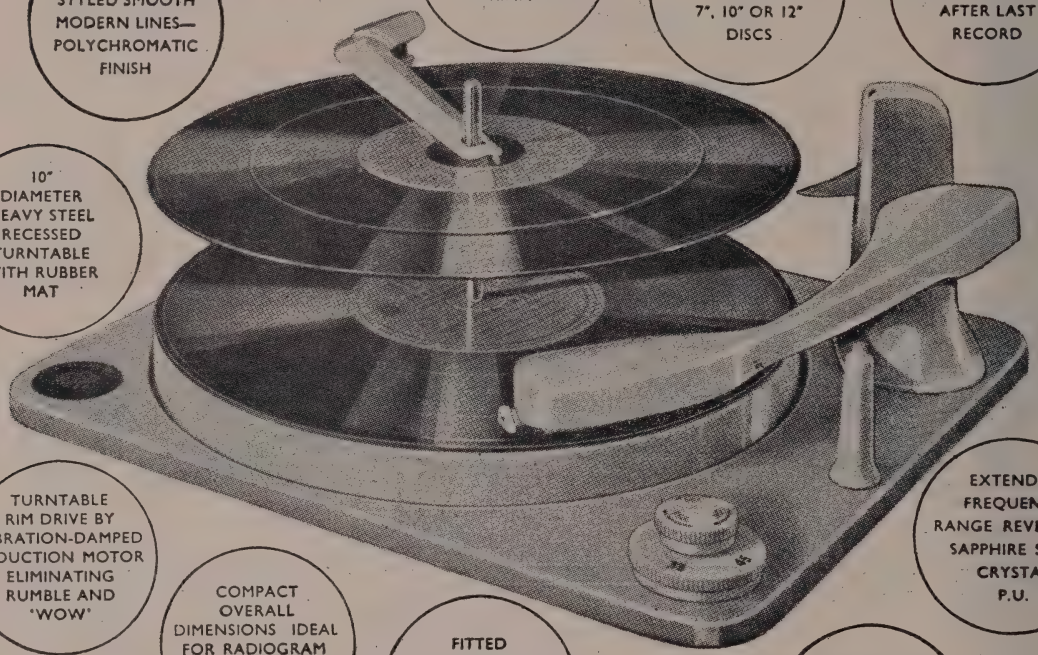

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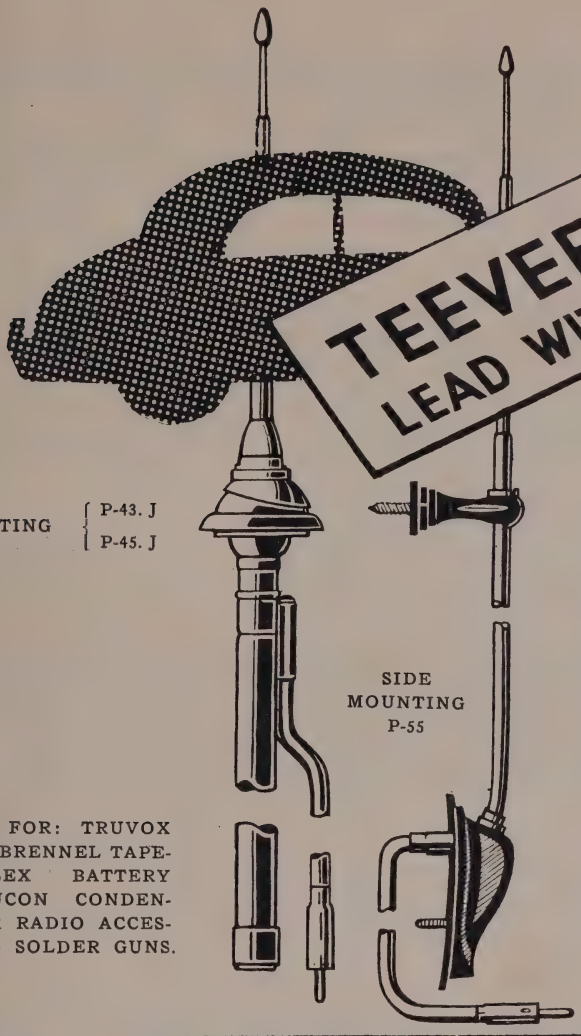

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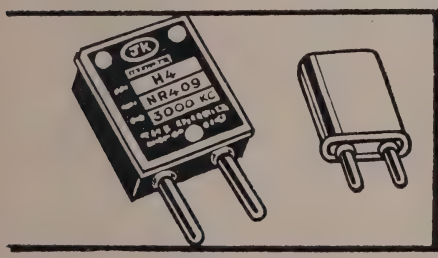

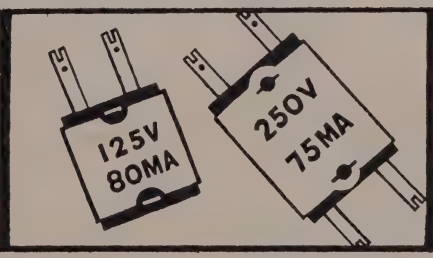

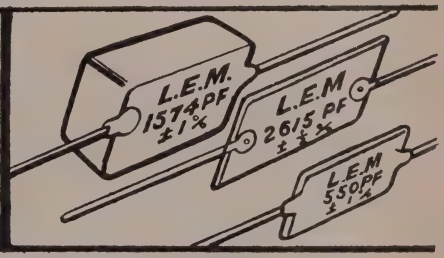

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Electrical Trading By Power Boards and Others

AT THE ANNUAL conference of the New Zealand Radio and Electrical Traders' Federation, held recently in Wanganui, a state of affairs was revealed which is of great importance to the whole retail electrical trade. It is that power boards, city councils, and other electrical supply authorities have for some years now been infiltrating into the business of selling electrical appliances direct to the public. Whether or not such bodies should be allowed to trade in this way is rather a knotty point, and the fact remains that there is nothing in the legislation governing electrical supply authorities which could prevent them from acting as appliance dealers. However that may be, the Federation feels, with more than a little justification, we think, that when supply authorities do trade in this way, the dice are heavily loaded in their favour. For example, a public body like a power board is much more heavily endowed financially than any private trader is likely to be, and is in a position to outlay as much capital as it sees fit in equipping and stocking a retail department. The capital with which it might do this has in many cases been obtained as a long-term loan, and although the money may not have been provided directly by Parliament, the authority to raise it has, with the specific intention of providing funds from which the supply authority should finance its reticulation, maintenance, and indeed all matters concerned with the efficient supply of electricity to the public. This being the case, it hardly seems fair or equitable that the authority should outlay a portion of this capital for the express purpose of competing with legitimate private traders. After all, the responsibility of providing and selling electrical energy has nothing to do with the business of selling the means of utilizing that power, and in our opinion at least, the trade is entitled to protection against this sort of competition.

Whatever may be one's belief on the ethics of trading by public bodies in this particular manner, there is one aspect of the case which gives the public body a very unfair advantage. Power supply authorities pay no income tax! This applies not only to their sales of power (which are taxed elsewhere) but also to their trading operations in the appliance field. There is clearly an anomaly here that was not foreseen when the laws relating to power boards were framed.

However, the Radio and Electrical Traders' Federation has not merely been talking about the problem: it has done something about it. Quite recently a deputation from the Federation, and other interested bodies was received by the Minister of Finance, and put before him a very cogent case for the removal of the anomaly. The matter is one which will probably require legislation to deal with it satisfactorily, and the sub-committee which had the onerous duty of the preparing the case to go before the Minister has reported to the Federation that Mr. Watts has promised to put it before Cabinet. What will be the outcome cannot be gussed at this stage, but the Federation is to be congratulated on its work, without which there would have been no chance at all of modifying the existing situation, which is a very real menace to the trade as a whole. It is action like this on the part of the Federation that emphasizes its great value to the retail radio and electrical trade, and which should bring home to all traders the necessity for a strong federated body. The Federation's activities have always been hampered to some extent by lack of funds, which in turn results from too small a membership in the constituent Associations. On the trade's own behalf, we would urge all those dealers who have not done so to join their local Radio and Electrical Traders' Association, and thus strengthen an organization which does much on their behalf, whether or not they are contributing members.

A NEW AUDIO LECTURE COURSE

Last year the Editor of this journal, Mr. W. D. Foster, B.Sc., gave in Wellington a series of three lecture-demonstrations on high-quality sound-reproducing equipment. The successful 1955 series was designed to appeal to those whose primary interest was listening to recorded music, and so contained little of a technical nature.

This year Mr. Foster has prepared a series of four lectures under the title of "The Technique of High-Quality Sound Reproduction", to be delivered in Wellington in late July and early August of this year. This time, the lectures are to be on a technical plane, and it is expected that they will be of value to both amateur and professional devotees of the subject. Topics to be covered include: the specifications and properties of disc and tape records; pickups and arms; the design and construction of high-quality amplifiers; response equalization for disc and tape reproduction; loudspeakers and their baffles; the appraisal of reproducing equipment; tape recording and reproduction.

Some of the finest available equipment will be on hand to demonstrate the high standard that can be reached, and the technical parts of the lectures will be illustrated by the use of the oscilloscope, and other special equipment, constructed specially in the R & E laboratory for the purpose.

Owing to the non-availability of the hall on Saturdays, and to heavy prior bookings, it has been found necessary to hold the lectures on the following Friday evenings, commencing at 8 p.m.:

July 21st. July 27th.

August 3rd. August 10th.

The fee for the series will be £2 2s. Those intending to be present are advised to order early, as the number of tickets is limited to the seating accommodation of the hall. It will not be possible to allocate tickets other than on receipt of fees, which should be addressed to "Radio and Electronics (N.Z.) Ltd.", P.O. Box 8022, Wellington.

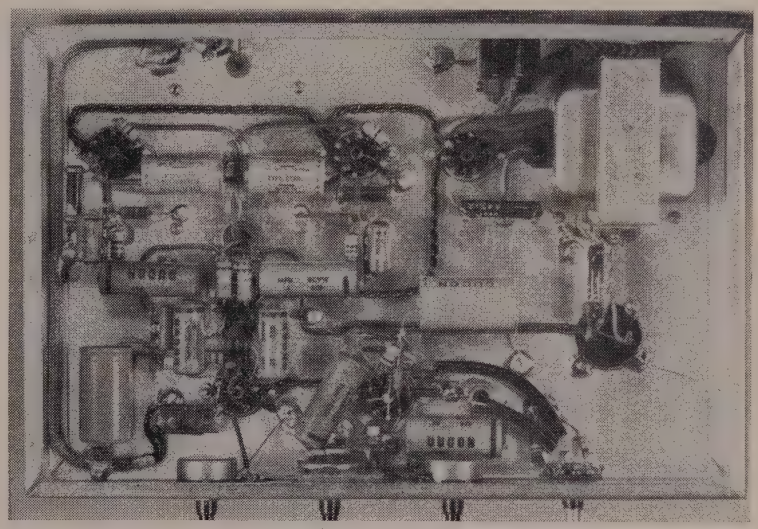
Audio

THE "R. & E." 1956 GRAMOPHONE AMPLIFIER

There appears to be a considerable demand among readers for a gramophone amplifier of high quality and medium power output, together with the usual response compensation and tone control facilities, assembled on the one chassis. The system described in this article meets this specification, and at the same time embodies the best modern amplifier practice.

INTRODUCTION

From conversations and letters that we have had, it seems that in spite of the wide variety of audio circuits that we have published over the years, there is always a need for something different. For example, it is often desirable to have the control unit of an audio system separate from the main power amplifier, and to judge from the design of most commercial gramophone amplifiers, one would be forgiven for assuming that such an arrangement was universally preferred by the purchasing public. It is for this reason that we have followed suit in our circuits for amateur constructors by, for the most part, designing main amplifiers as separate entities, with physically separate pre-amplifiers. The latter concentrate all the circuits associated with the operating controls in one place, and feed the signal over a cable to the main amplifier.



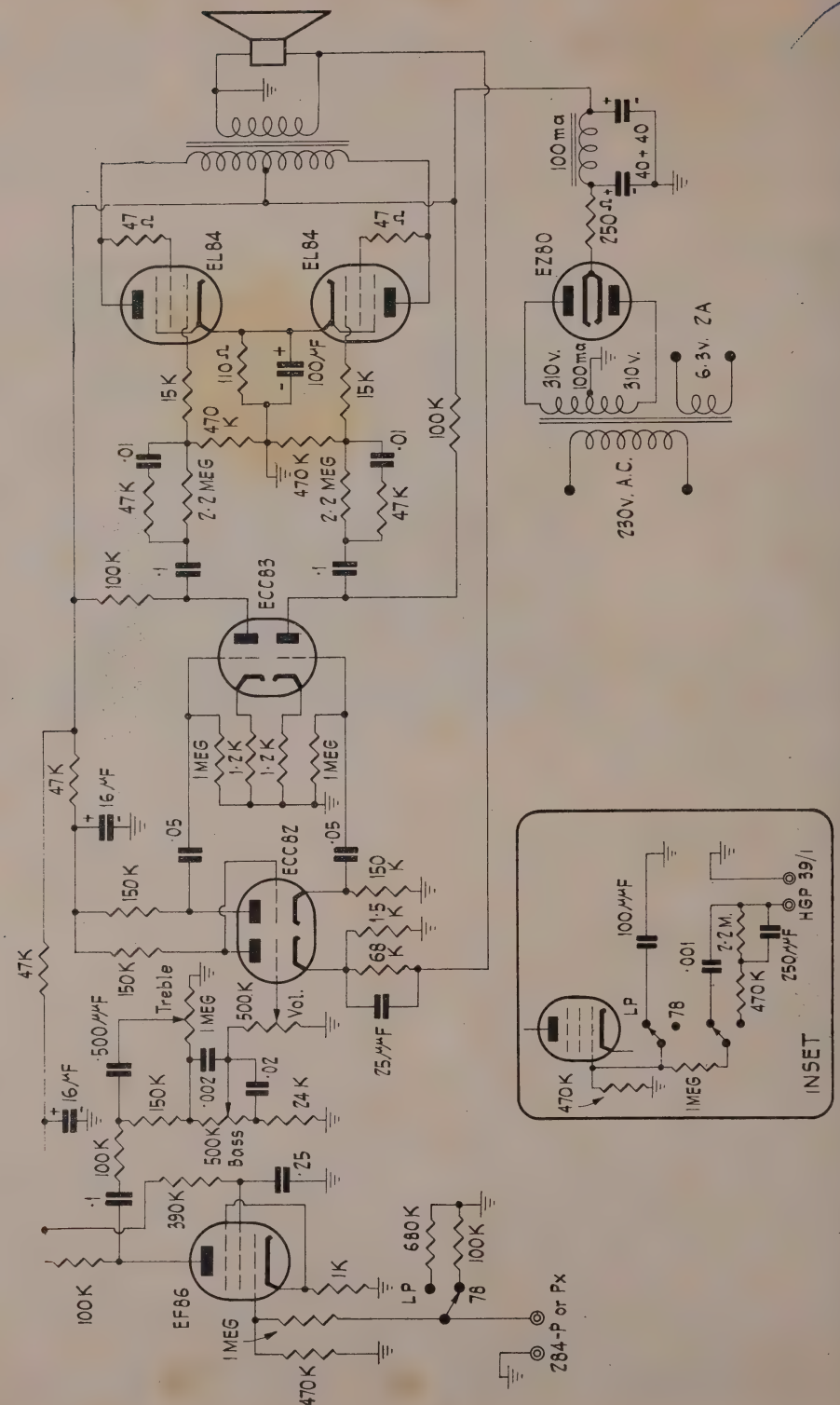
Underneath view of the amplifier chassis. Note the position of the smoothing choke in the right-hand top corner. This is directly underneath the power transformer. Directly in front of the choke is the 40 μfd. dual smoothing condenser. The valve socket to the left of the choke is the rectifier. The other valve sockets can easily be identified, the one near the middle of the chassis front being the pre-amplifier tube.

Perhaps the greatest advantage of this arrangement is that the small unit with the control knobs on it is easier to house in an accessible position than is the large chassis of the main amplifier. However, there are definite advantages in arranging things the other way about, with the whole "works" on the one chassis, even if mounting it suitably may be a little more difficult. For one thing, the difficulties associated with feeding the audio signal down a cable up to several feet long, without affecting the quality, are avoided altogether. By the same token, hum-free operation is rather easier to obtain because the possibility of inducing hum through a poor arrangement of earth connections is much reduced. Another advantage from the point of view of the man who does his own metal-work is that there is a good deal less "chassis-bashing" to do when the pre-amplifier and main amplifier are together. With modern small valves, there is no reason why the complete amplifier system, with its power supply, should require a chassis of unmanageable proportions. In the present instance, the chassis is only 11½ in. x 7½ in. x 2½ in., so that quite a small cabinet would house it and the gramophone motor or record changer, whichever is preferred.

THE MAIN AMPLIFIER

The power amplifier proper is quite similar to that used in the 9-valve radio-gramophone described in our January issue, and which turned out to be very popular indeed. For the benefit of those who prefer the Continental series of valves, these have been used this time, but the basic arrangement of the amplifier is very similar to the previous one. The output stage, using EL84, gives six watts of audio power at the voice-coil. The driver stage is push-pull, using both halves of an ECC83. The remaining valve in the main amplifier is an ECC82, one half of which is a voltage amplifier with a gain of some twelve times, direct-coupled to the other half, which acts as the phase inverter. The valves in this part of the circuit are carefully chosen so that the correct operating grid bias for the phase inverter is automatically obtained, in spite of the D.C. coupling.

Negative feedback is employed, from the voice-coil winding back to the cathode of the first valve. This gives a gain-reduction of 10 times or 20db., which is enough to reduce the distortion to very small proportions; there is a stability margin of some 10 db. This means that for the prototype, this much more feedback could be applied without danger of oscillation. It might be argued that if this is the case, more feedback should be used, but this does not follow.


EL84
EL84
47 Ω
47 Ω
110 Ω
100 μF
15K
15K
470 K
470 K
2·2 MEG
2·2 MEG
47K
47K
·01
·01
·1
·1
100K
100K
ECC83
1MEG
1·2K
1·2K
1MEG
·05
·05
47K
16 μF
150K
150K
ECC82
150 K
1·5 K
68 K
25 μF
47K
150K
Treble
1MEG
500K
Vol.
500 μμF
·002
·02
24 K
16 μF
100K
500K
Bass
·1
·25
390K
EF86
1K
1MEG
470K
LP
680K
78
100K
284-P or Px
100 ma
40+40
250 Ω
EZ80
310 v.
100 ma
310 v.
6·3v. 2A
230v. A.C.
INSET
470K
LP
100 μμF
·78
·001
2·2M.
470K
250 μμF
HGP 39/1
1MEG

In particular, the existence of the 10 db. margin means that if the circuit is constructed according to specification, builders will have this much leeway before striking trouble. For example, it allows for valves which might have higher-than-average mutual conductances, and for the fact that no close-tolerance resistors have been specified. Similarly, variations in performance of the output transformer will be more tolerable. Briefly, then, the existence of the stability margin means that the amplifier will be much more certain to perform properly than if more feedback had been used. Years ago, when large amounts of negative feedback were the exception rather than the rule, the lot of the amplifier builder (and of the designer, too) was much easier, but the vast improvements in performance that have since come about, have to be paid for in some way. As far as the designer is concerned, this means taking a lot more care in assessing the performance of his work, while for the builder, there is the responsibility of following the chosen design as closely as possible if he is to be assured of performance duplicating that of the prototype equipment.

OUTPUT MATCHING

In the original, the output transformer used was a 10-watt high-fidelity type, matching 5000 ohms to the speaker's voice-coil. The performance of this type of transformer will be superior to that of a similar one with a lower power rating. The next smallest is rated at only 5 watts, which in any case is below the maximum power output of the valves used in this circuit. Even if it were not, the distortion arising in the output transformer can be expected to be lower if a larger one is used, so that we do not recommend any attempt to economise by using a smaller output transformer than the one specified. One well-known transformer maker has a range of high-fidelity output transformers made with three grades of core material. The main difference in the performance of the three corresponding transformers is that the lesser ones have considerably smaller primary inductances than the best one of the three. In feedback amplifiers, this could cause difficulty, but in this one we have ensured that it is stable with the two higher grades of core material. It is suggestd that either of these be used, but not the one with the lowest grade of core material. The stability margin was quoted above as 10 db., and this applies to the case of the transformer with the super-silcore core. With the better transformer, which uses a radio-metal core, the stability margin at low frequencies will be higher than the 10 db. quoted.

SPECIAL CIRCUITS FOR STABILITY

It will probably have been noted that the grid circuits of the EL84 output valves look rather more complicated than usual. As always, with high Gm valves, grid stopper resistors have been used, and the grid leaks have the normal value of 470 k. In each grid, however, is to be found a network comprising a 2.2 Meg. resistor, a 47 k. resistor, and a 0.01 μfd. condenser. The purpose of this network in conjunction with the grid leak, is to provide a step in the response of the amplifier to frequencies below 15 c/sec. Now such frequencies are of no interest at all when it comes to reproducing music, but from the point of view of the amplifier itself, and its proper functioning, they are extremely important. When a large degree of negative feedback is applied to an amplifier of good characteristics, it is at very low, and very high frequencies that we must look out for trouble. As the feedback is increased, there will come a time when one of two things will happen. The amplifier will oscillate either at some frequency much higher than the audio range, or at a frequency that is much lower—usually in the range 1 to 5 c/sec. The latter is what is usually known as "motor-boating". Which oscillation shows up first as the feedback is increased depends on the amplifier design, but in either case, both types of oscillation have to be guarded against. The special networks in the grids of the output tubes have the purpose of reducing the amplifier gain in the very-low-frequency range mentioned, while producing very little additional phase shift. How such a network functions has been fully described in previous articles, so that we do not intend to go into the matter here, but we do want to emphasize that these networks should on no account be omitted.

The same thing applies to the small condenser of 25 $\mu\mu$fd. that is connected across the 68 k. feedback resistor. The purpose of this is to provide more feedback at super-audible frequencies, and so to level off the rise in response that occurs above 100 kc./sec.

A frequency response curve was taken on the original amplifier, and was found to be flat from 16 c/sec. to 200 kc/sec., after which there was a gradual roll-off, without any rise above the general level of the curve.

FEEDBACK WITH VARIOUS SPEAKER IMPEDANCES

The high-fidelity output transformers mentioned are not of the multi-match type—high-quality transformers hardly ever are—but they have four secondary windings which may be inter-connected according to the chart supplied with them so that they match speakers of 15, 9, 4, or 1 ohms. When feedback voltage is taken from the voice-coil winding of the transformer, as it is here, the amount of feedback actually obtained depends not only on the values in the feedback voltage divider, but also on the impedance of the speaker. Thus, when speakers of different impedances are used, it is necessary to make simple changes in the feedback network in order that the degree of feedback will be the same for all speakers. The voltage divider in this circuit consists of a 68 k resistor and a 1500 ohm resistor in series, connected from the 'hot' end of the voice-coil winding to earth. A fraction of the output voltage is then fed back to the amplifier input by making the 1.5 k. resistor the cathode bias resistor for the first tube in the circuit. For accommodating speakers of different impedances it is not necessary to change the 1.5 k. resistor, nor is it desirable, because to do so would alter the bias on the first valve. Instead we change the 68 k. resistor, so that a different percentage of the output voltage is fed back. The following table gives the values to which the resistor should be changed, and also the values for the condenser across it, which must be changed at the same time. The values inserted in the circuit are suitable for a 15 ohm speaker.

Speaker Impedance	Value of R	Value of C
15 ohms	68 k.	25 $\mu\mu$fd.
9 ohms	47 k.	35 $\mu\mu$fd.

4 ohms	33 k.	50 μμfd.
1 ohm	15 k.	100 μμfd.

Readers will note that the nearest preferred-value resistor sizes have been chosen, because great accuracy in the choice of the resistors is unnecessary. This is because the amount of feedback is inversely proportional not to the value of the resistor, but to the square root of its value. Also, to get the approximate capacity values needed, parallel combinations will have to be used for some of the values.

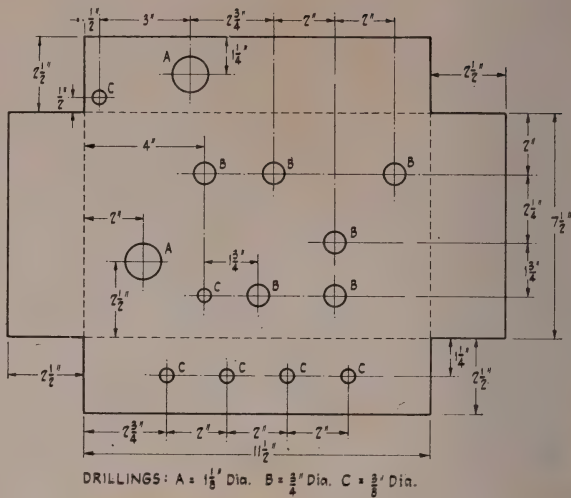
TONE CONTROL AND PRE-AMPLIFIER CIRCUITS

An amplifier intended for gramophone record reproduction can hardly be regarded as complete without some means of varying the frequency response to suit various conditions. As we have mentioned before, the conditions under which records are made vary so widely as to make independent bass and treble controls a necessity. Such things as microphone placement, acoustic properties of the place where the recording was done, acoustic properties of the room in which the reproducing is carried out, and the characteristics of the loudspeaker system used all may have an effect on the frequency response which gives the most realistic or most pleasant-sounding result for the listener. In general, all these things can be compensated to good effect by means of two simple controls—one affecting only the frequency range below about 250 c/sec., and the other taking effect only above about 2000 c/sec. Each control is arranged so that at some position near the centre, the response is flat. Turning the control clockwise from this position produces a boost in the response region affected by the control, while turning it in an anti-clockwise direction gives a reduced response, or cut, in the same region.

Many of the circuits that used to be recommended for controls of this sort had a grave defect in that they affected the general volume level at the same time as they altered the frequency response. These days, however, there is no need to have controls which work in this way; the middle frequencies, between 250 and 2000 are those which determine the impression of volume, and in the tone control arrangement used in this amplifier, this range of frequencies is so little affected, when either or both controls are turned from the flat response position, that the effect on volume is absent altogether.

The tone control circuit has been placed between the EF86 preamplifier valve and the main amplifier, so that the volume control potentiometer comes after the first valve in the circuit. Because of this, it is important to ensure that the first valve is never overloaded by the signal, for if this were to happen, there would be distortion at all settings of the volume control. We will have more to say on this subject later, under the heading of the input circuit.

From the plate of the pre-amplifier valve, there is a chain of resistors to earth. These comprise a 100 k., 150 k., 500 k. potentiometer, and a 24 k., all in series. Of these, the bass control is the 500 k. potentiometer, the output from the network being taken from the moving arm, straight to the volume control potentiometer. When the pot is at the upper end of the control, the upper, 0.002 μfd. condenser is shorted out leaving the lower, 0.02μfd. condenser connected across



the 500 k. In this position, the 0.02 μfd. condenser acts as a conventional bass boost circuit, together with the resistors above and below it in the chain, while the 500 k. resistor has almost no effect. Thus, with the slider at the upper end of the 500 k. potentiometer, we have maximum bass boost. Now when the slider is taken to the other end of the pot, the 0.02 μfd. condenser is shorted out of circuit, leaving the 0.002 μfd. one in. This condenser then acts as a too-small coupling condenser, giving bass attenuation. At some point approximately in the middle of the control, the two condensers are effective, and their effects are complementary, so that there exists some position of the control in which the bass end of the response curve is quite flat.

The treble is controlled by the 1 Meg. potentiometer. This is connected through the 500 μμfd. condenser to a point high up on the voltage-divider chain, via its moving contact. One end goes to earth and the other to a point lower down on the resistor chain. When the moving contact is at the earth end, we have the 500 μμfd. condenser bypassing most of the resistor chain, and giving treble attenuation. When it is at the other end, the 500 μμfd. condenser is bridged right across the 150 k. resistor, giving treble boost. Again, there is some central position of the control where the two effects are exactly complementary, and cancel out, giving a flat treble response. Circuits like this one can work very well, or they can be pretty unsatisfactory. Their success or otherwise depends not on the configuration of the circuit, but on the choice of components. In the present instance, this has been done very carefully so as to ensure that neither control affects the middle-frequency response, or the response at the opposite end of the audio-range. Builders are warned against altering any of the values in this part of the circuit, in case this desirable performance is impaired. One advantage of the present circuit is that there is less signal loss than is the case with many other schemes, some of which attenuate the signal by as much as 100 times in providing the required boost at both ends of the scale. We have sometimes been asked for bass or treble boost circuits which do not

cause any signal loss at all, and we would be only too glad to oblige, if such circuits existed. Unfortunately, they do not, because all such arrangements not employing amplifier valves, can only boost one part of the frequency range by attenuating all the rest. It then becomes necessary to insert extra amplification in order to make up for the losses involved in the boost circuit. To make this somewhat Irish-sounding explanation a little clearer, let us take an example. Suppose, for instance, that we want to be able to provide a maximum of 20 db. boost at 50 c/sec., with of course correspondingly less at higher frequencies, up to some point at which the response stays level. Suppose this latter is 300 c/sec. We can tackle the problem in two ways. Either we design an amplifier circuit so that it has a gain of one at 300 c/sec., and at all higher frequencies, but its gain steadily increases below this frequency, reaching the required figure of 20 db. or ten times, at 50 c/sec., or else we design a network of resistors and condensers which gives no signal loss at 50 c/sec., a steadily increasing loss up to 300 c/sec., where the loss is 20 db., and a constant loss of this amount at all higher frequencies. The latter scheme has dropped the middle and high frequencies to a tenth of the voltage at the input end of the tone-control network, so that to bring the level back to its former value, an additional amplifier stage with a gain of ten times must be used. It will be seen that in either case, a valve has had to be used. The only difference between the two schemes is that the first uses an amplifier to actively boost the frequency range of interest, while failing to amplify the range we want to leave flat, while the latter is a passive arrangement, in which a network gives the desired result by attenuating the portion of the range that does not require boosting.

The tone control circuit used here is of the second type, the only difference being that we build up the signal by amplification **before** it passes through the tone control circuit. Then, after the latter has done its worst, by way of attenuation, the signal that is left is of the order we want, to drive the main amplifier.

THE INPUT CIRCUIT

Since high-quality crystal pick-ups have become available, many amateur builders have used them with every satisfaction. The prejudice that used to exist towards crystal types is fast disappearing, and, we think, with good reason. One of their greatest advantages is that they really do give high-quality results at a very reasonable price. In general, magnetic pickups (including the so-called variable-reluctance types) of high quality are much more expensive, and their output voltages are much lower. Thus, while we keep an open mind on the question, believing that both crystal and magnetic types, when of the best quality, give very comparable results, we know that many of those who build and use amplifiers will prefer the crystal pickups for one or more of the reasons given above. Accordingly, the input circuit of the present amplifier has been given in alternative forms; one, used in the main diagram, is for the Ronette 284-P or PX, and the other, in the inset diagram, is for the Acos HGP-39-1.

In case these arrangements (especially the first) should seem too simple to be true, it should perhaps be pointed out that both sets of compensating circuits are in conformity with the latest recommendations of the manufacturers of these pickups, and have been found to work very well.

The pre-amplification needed is not nearly as much as a pentode-connected EF86 can provide, but somewhat more than a triode stage would give. A way out of this difficulty is to use the pentode connection, but to leave the cathode resistor unbypassed, thereby giving a stage gain intermediate between triode and pentode.

An important point is the voltage divider at the grid of the EF86. This applies only about one-third of the total pickup output voltage to the grid, and its purpose is to safeguard the pre-amplifier valve against overload. Since the volume control comes after the first stage, the slightest suspicion that too much signal may be fed to the first valve must be avoided—a point that has already been mentioned, but which can bear repeating, since most circuits avoid this possibility simply by having the volume control at the input grid. However, as long as first stage overload is avoided, there is a distinct advantage in having the volume control a bit later. It is that less amplification **after** the gain control makes it less important to have an absolutely noise-free-control. Sometimes people wonder why a certain circuit seems to need the volume control potentiometer replacing after a relatively short spell of duty, when the reason is simple, namely that there is too much amplification after the control, amplifying the noise made when it is moved. In that case, only a brand new pot, that is virtually noiseless, will not cause crackles and thumps in the speaker when it is adjusted.

CONSTRUCTION

The construction details of this amplifier are quite normal, no special tricks having been indulged in in order to make the unit more compact. One person who saw the original in our office before this was written seemed very surprised that a complete high-quality audio amplifier could be built into so small a space, but the under-chassis photograph shows that there is no over-crowding of parts, and that all the requirements of good lay-out have been met.

Along the back of the chassis we have the power transformer, the rectifier valve, and the output transformer, with the output valves on either side of it. Directly in front of the transformer are the ECC83 and the ECC82. To the left of the latter is the EF86 pre-amplifier valve, and the input socket may be seen to the left of that again. The controls, reading from left to right, are as follows: 78-L/P switch, bass control, treble control, and volume. The switch is to the left of the input socket, and the two are connected by a short length of shielded wire. It was not found necessary to shield the leads from the switch to the EF86, or any of the wiring associated with the tone-control circuit. The latter is wired round the two potentiometers, with tie-points provided by means of insulated solder lugs, where necessary. Most of the wiring is by the point-to-point system, and the photograph of the underneath of the amplifier illustrates that this sort of wiring need not degenerate into a bird's-nest, or deserve an even more uncomplimentary description. The best way to avoid this is to take thought about the orientation of the sockets before their mounting holes are irrevocably

drilled. For example, if the socket of a particular valve is turned in such a way that the output condenser, soldered to the plate pin, has to cross over the socket on its way to the next valve's grid pin, one quickly finds that the grid connection also has to cross the socket, and that a neat and logical layout of the small parts becomes impossible. In many instances, the positions of the mounting screws of the sockets may be seen in the photograph, and we know that some readers take note of this, and drill their chassis accordingly, in a laudable attempt to duplicate the layout. Unfortunately, however, this does not always work, because different brands of socket sometimes have the mounting holes in different relative positions. Thus, a surer guide is to locate on the photograph one particular valve pin. In audio work, the plate and grid pins can usually be identified, or if both cannot be, one of them can. This will then indicate nearly enough how the socket should be turned so that the wiring can be made to duplicate the layout of the original. One part of this circuit definitely requires insulated tie-points to be provided—namely the circuit between the plates of the ECC83 and the grids of the output valves. The networks discussed earlier in the article cannot be installed without some intermediate support, and the photograph shows how small strips of insulated solder lugs have been placed so as to accommodate the additional grid circuit components.

It will be noticed that many of the small parts that have to be connected to earth have been soldered directly to the chassis, and some may wonder whether this, or the contrary practice of attaching all earth connections to a bus-bar, earthed at only one point, is the better. Both can be successfully used, and there is yet a third method, whereby solder lugs are bolted to the chassis, usually with the small nuts and bolts that mount valve sockets and the like, and all earths are made to these lugs. Which of the three should be used depends on circumstances—not the least of which is the material of which the chassis is made, and the manner in which it is finished. For instance, if the chassis is made of aluminium, earth connections clearly cannot be soldered directly to it. In this case, either the bus-bar method, or the screwed down solder-lug scheme must be used. We ourselves prefer the latter, but it is purely a matter of personal preference, allied to a consideration of the particular job in hand. If, as here, the chassis is of steel, cadmium-plated, it is quick and easy to solder directly to the chassis, provided one has a large enough iron. However, such joints do take more heat than soldering small lugs, and care must be exercised in making them, for the constructor's most grievous enemy, bar none, is the dry joint!

However, when this method is used, there are certain rules that should never be broken. The most important of these is that in a feedback amplifier, where the feedback is taken from the voice-coil winding of the output transformer back to the first stage, the voice-coil should **not** be earthed to the chassis by the shortest route, but a wire, insulated from ground, should be led to the earth-point for the first stage, and earthed there. This is a theme on which we have often enlarged, but it is such an important one that we make no apology for mentioning it again.

The second occasion on which it pays not to use direct earthing, but to give an amplifier valve a single earth point, to which the grid, cathode, screen, and plate circuits are all earthed, is when the signal level is low. In audio work, this applies mostly to low-level stages handling the output of pick-ups, microphones, tape heads, and the like, whose outputs can be measured in millivolts rather than in tenths of a volt.

Apart from the above short pep-talk, which would really be in place in any constructional article, there is little or nothing about the present amplifier that calls for special mention.

SETTING UP THE TONE CONTROLS

Before we leave the amplifier, a few words may be helpful in assisting the builder to find the settings of the bass and treble controls that give a flat frequency response. It is necessary to do this, because the setting mentioned is the only one that can be used as a yardstick by which to recognize the deviations from a flat response that individual records might need. One way is to obtain a test record—one of those which has a series of narrow bands each giving a known frequency. In general, these records are made in such a way that their frequency response duplicates that with which musical records are made. Thus, if the tone controls were absent, playing the record with the L/P-78 switch in the appropriate position should result in a flat response at the output of the amplifier. The easiest way to judge the response is to connect an A.C. voltmeter to the voice-coil winding of the output transformer, and to note whether the voltage output is the same over the whole record. A very good one to use is the Decca LXT 2695. This covers the audio range from 30 c/sec. to 15,000 c/sec., and is a very good investment for anyone interested in audio work, being much less expensive than an audio oscillator. To use it for setting up the tone controls, first of all find the band which gives 1000 c/sec. This is played, and the volume turned up until the output meter gives some convenient reading. It should be noted that variation of either or both of the tone controls will have a negligible effect on the output voltage at this frequency. Next, play the band giving 100 c/sec. Note first that moving the treble control has no effect on the output voltage, but that moving the bass control can take the output from well below the output to which the 1000 cycle note was set, to well above it, depending on the setting. Finally, adjust the bass control until the output voltage is the same as that at which the 1000 c/sec. note was originally set. Note that if the volume control has been shifted since the 1000 c/sec. level was set, it must be re-set before finding the bass control setting. Then, set the treble control by playing the band giving 5000 c/sec., and again making the output the same as for the other two test frequencies. When this has been done, mark the settings obtained for the controls, so that they can be returned to these positions at will. Then, if the whole frequency record is played through, it should be found that the output voltage will vary only slightly over the whole audio range. Some variation must be expected at the extreme top end, however, because of the pickups mentioned, the Ronnette P and PX have different maker's specifications. The former can be expected to roll off quite sharply above 10,000 c/sec., while the latter should carry on without difficulty to 15,000 c/sec. In addition, it is at the

(Concluded on page 50)

A NOVEL MAGIC-EYE INDICATOR CIRCUIT

In its usual applications, the common-or-garden magic-eye tube, or cathode-ray indicator, to give it its official title, does nothing more than indicate the presence or absence of a negative potential on its control grid, and to give a rough indication of the amplitude of this potential. This is all the tube is asked to do, for example, when it is used as a tuning indicator in a radio receiver, or as a null indicator in a bridge circuit. The same form of operation is used when a magic-eye tube is used instead of a moving coil meter as an indicator of audio level in tape recorders, amateur transmitters, and the like. This simple form of application covers most of the possible uses for the tube, but its range of usefulness can be extended considerably if it is enabled to indicate not only the magnitude of the D.C. input voltage, but also its polarity.

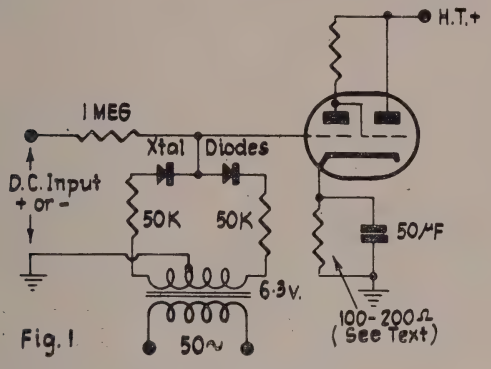


Fig. 1

The other day, in the course of our reading, we came across a simple, yet ingenious method for making it do just this. One method of making the tube indicate whether the input voltage is positive or negative in polarity with respect to earth would be to bias the control grid negatively by a fixed amount, so that the shadow was only half closed. Then, if the eye closes more than this, the input voltage must be negative, while a positive input voltage will open the eye. The chief difficulty about such a scheme is that of estimating whether the edge of the shadow has in fact moved by a small amount. Putting a mark on the glass envelope would not be a very satisfactory solution, because parallax would make reading difficult. The best way to overcome the difficulty would be to make the shadow itself act as a reference mark, as well as moving to give the desired indication. This sounds as though it might be quite a difficult problem to solve, but as long ago as 1948, M. L. Greenough, of the American National Bureau of Standards, devised a very neat method, illustrated in Fig. 1.

The D.C. control voltage is fed to the grid of the magic eye tube through a 1 Meg. isolating resistor. The grid is connected also to a circuit comprising two diodes, a pair of 50 k. resistors, and a transformer winding providing 6.3 volts at 50c/sec. The transformer is centre-tapped, and two diodes are used in order to prevent a large 50-cycle voltage from being applied to the grid of the eye, thus obscuring the proper indication. It will be noted that the crystal diodes are so connected that they both conduct simultaneously. Thus, on one half-cycle of the input voltage, they both conduct. At this time, the diodes can be regarded as a short-circuit, so that the two 50 k. resistors are connected to earth from the grid of the magic eye tube. The D.C. input voltage is

Fig. 2

therefore subjected to voltage division before being applied to the grid of the magic eye tube, only a negligible fraction of it being allowed to appear. Effectively, therefore, the diodes remove the input voltage altogether while they are conducting, and during this time, the shadow of the magic eye takes up the position which it normally would with no input voltage applied. On the opposite half-cycle of the A.C. input voltage, the diodes are biased in their non-conducting direction, and they act as open circuits, effectively disconnecting their associated circuit from the grid of the magic-eye tube. During this half cycle then, the full D.C. input is applied to the grid of the eye tube. If the polarity is negative with respect to earth, the shadow will close, but if it is positive, the shadow will open somewhat.

The visual effect is difficult to show on a diagram, because in practice, the shadow moves, but we have attempted to illustrate it in Fig. 2. In effect, there are two shadow angles, one which remains fixed, while the other varies according to the signal. Actually, of course, the two pictures are being presented to the eye one after the other, as the switching takes place at the 50-cycle rate. The reference condition of zero signal is very readily distinguished, because then, the edges of the two shadows coincide exactly —a condition that can be determined very accurately by eye.

INCREASING THE SENSITIVITY OF A MAGIC EYE

The usual method of increasing the sensitivity of a magic eye is to use amplification ahead of it, where this is possible, before rectifying and applying the output of the rectifier to the grid of the tube. This is all very well for applications like null indicators in bridges, or in level indicators in which signals of several volts are available, but it will not work, for example, in the case of a radio receiver, where the D.C. input is obtained from the detector diode. In this case, it would be possible to use a separate I.F. amplifier specially for the magic eye tube, which would then have its own separate detector, but this would be a very expensive way of achieving the desired result. Very few people seem to realize that there is a very simple and effective way of increasing the sensitivity of any magic eye circuit, at the expense of a single ½-watt resistor! The trick is simply to connect the resistor in the cathode circuit of the eye tube. This gives **positive** feedback, in the following way: The built-in amplifier is directly coupled to the indicator portion of the tube. Thus, when a negative

(Concluded on page 49)

No. 104: PULSED OPERATION OF TRANSMITTING TUBES

INTRODUCTION

In the valve manuals, transmitting tubes are rated for only two main types of operation, i.e., continuous service, and I.C.A.S., which stands for Intermittent Commercial and Amateur Service. It will be noted that the latter refers to such applications as mobile and amateur transmitters, in which short periods of use are interspersed with rest periods. Under such conditions it is logical to suppose that valves can be operated at higher ratings than when operation is continuous. A good example of this is the ordinary Class C amplitude-modulated amplifier. Here, current and voltage at the peak of the modulation cycle are each twice the values that obtain when the modulation is absent, and the peak power is four times the carrier power. However, on account of the intermittent nature of modulation, even by a sine-wave, these peak currents, voltages, and powers can be handled by the tubes without damage, and the slight reduction in quiescent plate voltage that is recommended compared with C.W. conditions of operation, by no means reduces the peak conditions to anything approaching the C.W. ratings of the same valves.

Modern technique is uncovering more and more applications for large valves in which the operation can be described as pulsed, so that for the greatest economy in design, it is essential for users of such valves to have some idea of the way in which tubes can be up-rated under pulsed conditions. Unfortunately, it is not feasible to include in data sheets enough information to cover the many types of pulsed operation. Instead, this short article discusses the general problem, and shows how intelligent estimation may be used to enable pulsed circuits to be designed with the utmost economy in valves, consistent with normal life expectancy.

LIMITING FACTORS IN VALVE USAGE

There are three main factors which prevent a tube from being up-rated indefinitely. These essential limitations are:

(1) Cathode or filament emission,

(2) Breakdown voltage between electrodes, and

(3) Temperature at which the internal and external components lose their electrical or mechanical properties.

On the other hand, the chief feature of pulsed operation that allows up-rating to take place at all is the intermittent nature of the valve's operation. The actual kind of pulsed operation can vary between quite wide limits, so that it becomes useful to distinguish between three categories, as follows:

(a) **Intermittent Operation,** defined as a type of service in which the period of operation does not last longer than five minutes, and where every "on" period is followed by an equally long, or longer "off" period.

(b) **Long Pulse Operation,** in which the periods of operation vary between 0.1 seconds and 5 minutes. Generally, the duty cycle varies between 0.5 and 0.01.

(c) **Short Pulse Operation,** with pulse durations of less than 0.1 second. For most cases, the duty cycle lies between 0.01 and 0.001.

(In the above definitions, the term Duty Cycle has been used without definition. It means simply the ratio between the "on" period and the time duration of one complete "on-off" cycle. Where the pulses are all of equal duration, and occur at a fixed frequency, the duty cycle is synonymous with the fraction of the time during which the tubes are "on". It can be defined numerically as **t/T**, where **t** is the time of one pulse, and **T** is the time of one complete on/off cycle. But the frequency of the pulses is equal to **1/T**, so that the duty cycle can also be defined as **t.F**, where **t** is as before, and **F** is the pulse repetition frequency).

Having now defined the three main types of operation, it is now profitable to discuss the three limitations to valve ratings separately, with regard to each.

CATHODE OR FILAMENT EMISSION

The most fundamental limitation here is that the peak cathode current of a valve can never exceed the saturation emission current of the cathode or filament. Except for very large valves using pure tungsten filaments, the saturation emission of the cathode is always considerably greater than the normal peak current. This is a necessary condition for satisfactory life of the valve. However, for very small duty cycles (i.e., where the rest period is much longer than the pulse duration), it is possible to use such a high peak current that during the pulse, the emission falls off. It has been found that provided the duty cycle is small enough, the reduced emission is recovered during the rest period, so that useful valve life can be had at peak pulse currents which would be great enough to damage the cathode had the duty cycle been greater.

One example of this kind of operation has already been given, namely Class C plate modulation, while another common one is to be found in equipment generating large amounts of R.F. power for industrial purposes. Here it is common practice to apply raw A.C. to the plates of the valves, which are said to work under self-rectifying conditions. As the tubes are active during a maximum of half the time, and in practical Class C cases, a good deal less than this, higher peak currents are allowable. In the following paragraphs, suggestions are made which will allow

an estimate to be made of the maximum permissable peak and average cathode currents in any one case.

Thoriated Tungsten Filaments

For this type of cathode, the maximum possible emission current can be taken as between 50 and 70 ma. per watt of filament power. For example, the Philips TB 2/500 is a triode with a maximum plate dissipation of 300 watts, and a thoriated tungsten filament taking 7.3 amps at 12 volts. The filament power is thus 87.6 watts. The maximum emission is therefore between 6.1 and 4.4 amps. For short pulse operation, as defined above, the maximum peak cathode current can be equal to the saturation current, provided that the cathode current is oscillating at at least 10 kc/sec., as in pulsed oscillators or amplifiers. For D.C. pulses, as in pulse modulators, the peak current can also be equal to the emission current provided that the pulse does not last longer than 100μsecs. For longer pulse lengths or greater duty cycles, the peak current should not be greater than 0.5 times the emission current. If shorter than normal life is acceptable, an increase in 5% of filament voltage can be applied. This will increase the emission current by 100%, enabling the tube to be further up-rated.

Oxide-coated Cathodes

This type of cathode behaves quite differently from the thoriated tungsten type. It is used only for the smaller transmitting tubes, and for receiving tubes. There is no fixed saturation current, as increasing the plate voltage gives an increase in emission. Similarly, in pulsed operation, the saturation current depends on the pulse length. For pulse lengths up to 3 sec., peak cathode currents of 500 ma. per watt of filament power can be used, but for greater pulse lengths, this figure must be reduced.

Breakdown Between Electrodes

Apart from increasing the peak cathode current, valves can be up-rated with respect to plate voltage and negative grid voltage. The reason for this is that breakdown of dielectrics under high voltage is a function not only of the voltage, but of time as well. Thus, for pulse operation, higher than normal electrode voltages may be applied. This is why, in plate-modulated circuits, the peak R.F. voltage between plate and cathode can be higher than the D.C. voltage. Similarly, the same effect allows the peak R.F. voltage at 100% modulation to be higher than that during telegraphy conditions. At very short pulse conditions, where the pulse is only a few microseconds long, still higher voltages can be allowed.

In considering voltage breakdown, not only internal conditions, but breakdown external to the valve must be taken into account. Thus care must be taken that the voltages applied to the tube will not cause breakdown between pins of the valve, or between socket contacts. There is also the question of electrolysis taking place in the glass of the envelope when high voltages are applied, or when frequencies higher than the normal maximum for the tube are being generated.

KINDS OF PULSED OPERATION

There are two main kinds of pulsed operation of tubes, viz., pulsed anode and pulsed grid operation.

Pulsed Anode Operation

This is the type of operation in which H.T. is applied to the tube only in short pulses. In general, the voltage of such pulses can be much higher than the normal maximum D.C. voltage, and may be as high as twice this figure. This makes the peak plate voltage correspond with the peak voltage which occurs with 100% modulation under Class C telephony conditions, namely four times the limiting value of D.C. plate voltage. The above figures apply to a pulsed oscillator or amplifier, but if the tube is being used as a pulse amplifier, without R.F. oscillation, the peak pulse amplitude can be twice as much again, i.e., **four times** the limiting D.C. plate voltage for CW conditions. If pulsed anode operation is applied to a tetrode, care must be taken that between pulses, the screen-grid current does not rise so that the maximum screen dissipation is exceeded. This is always avoided where the screen is pulsed simultaneously with the anode. In this case, the screen voltage can be twice the figure quoted for anode modulation of the valve. In pulsed-anode operation, in which the tubes are used as amplifiers, the grid driving voltage is supplied from a separate stage. Care must then be taken that the grid dissipation is not exceeded.

Pulsed Grid Operation

In this type of operation, plate voltage is applied continuously to the tube, so that the maximum plate and screen voltages, as quoted in the data sheets for Class C telegraphy, must not be exceeded.

TEMPERATURE

Whatever the type of operation of a tube, the absolute limits of operation are set by considerations of temperature rise. The temperature that any component part of a tube will reach depends on the dissipation, the time for which it lasts, the duty cycle, the amount of heat the part can store, its ability to radiate heat, and the ease with which heat can be removed from it by conduction to other, cooler parts of the tube.

In any tube, the most critical parts with respect to temperature rise are the anode and the control grid. The thermal capacity of the anode depends on its construction. Carbon anodes are perhaps the best in this respect, because they can take several minutes to reach a stable operating temperature. Thus, for pulses up to 30 seconds in duration, only the average dissipation need be considered. In such a case, operation is likely to be limited by voltage breakdown, or by grid heating rather than by anode heating.

At the grid, however, the situation is very different. The wires of the grid structure are very thin, and have a low thermal capacity, so that they reach their operating temperature in a short time. The maximum grid dissipation should not be exceeded for longer than 0.1 second, and the average grid dissipation is an absolute maximum, which may not be exceeded at all. Because of its low thermal capacity, no greater grid dissipation can be allowed at pulsed operation than for continuous operation. Under any condition of operation, an unescapable condition is that the maximum safe bulb temperature may not be exceeded.

SOME OTHER POINTS

During pulsed or intermittent operation, it is sometimes possible to operate pulses at frequencies higher than their normal maximum, but if this is done, care should be taken that the valve leads do not overheat, and cause local fractures in the glass envelope.

(Continued on page 50)

Amateur Topics

NEUTRALIZING CIRCUITS

We have often wondered how many transmitter troubles are traceable to improper neutralization of R.F. power amplifiers. Among the difficulties that can be attributed to this cause are final amplifiers that function perfectly on 80 and 40 metres, but consistently or otherwise refuse to do their stuff properly at any higher frequency, back-wave, due to amplifiers that oscillate when the key in an earlier stage is up, modulated amplifiers that should "sound just like broadcast quality, O.M.", but don't, and other modulated amplifiers that produce fuzz and spurious sidebands quite a long way from the carrier frequency, calling down upon the owner the wrath of other amateurs. This list is by no means exhaustive, but even so it may strike a chord of memory in relation to some half-forgotten obscure transmitter fault that could be cured only by wrecking and re-building.

True, neutralization is one topic about which such tomes as the A.R.R.L. Handbook go into some detail, and one would think that enough had been written on it to prevent anyone from suffering from badly neutralized amplifiers, but some fresh writing on an old subject is often helpful, if only because it sends one back to the text-books, or starts a new line of thought that may be followed up with advantage. It is not that neutralization is a very difficult subject, or that it is a hard job to neutralize a stage correctly; rather is it a thing that becomes done "because the book says so" instead of because the doer fully understands what it is all about. Most of the common neutralization circuits have a habit of appearing very similar, and the writer for one, has on occasions fallen into the trap of using an unsatisfactory arrangement, simply through carelessness! With these thoughts in mind, the present brief survey of neutralization methods and circuits has been prepared in the hope that it may prove of assistance to some at least of our many amateur readers.

NECESSITY FOR NEUTRALIZATION

Perhaps the first step towards successful neutralization is to know in the first place why an R.F. power amplifier needs such treatment. Almost anyone, if asked, might answer "to prevent it from oscillating", but strictly speaking, this is not correct. At least, if it is, it is only a partial answer. Nor is this statement merely a piece of useless pedantry, for some of the most troublesome effects of improper neutralization are not due to oscillation at all, but to regeneration which may not be great enough under any conditions to cause oscillation. The real necessity, therefore, is to prevent regeneration. This, however, does not take us very much farther, the immediate question then being, "How does this regeneration come about?"

Unfortunately, the answer to this one is not really simple, and to many people is rather confusing, because the books all say that the regeneration comes about owing to the grid-plate capacity of the valve. Now this is quite true, but the said confusion comes about when the same book, in the section on audio amplifiers, shows how **degeneration,** or negative feedback, the exact opposite of regeneration, is obtained by intentionally feeding signal back from the plate to the grid. Fortunately, the contradiction is only apparent, because the difference between the two things is due to the fact that one is a tuned amplifier, and the other is not. The tuned amplifier is the one we are most interested in at the moment. Let us take a look at Fig. 1, which shows a triode R.F. amplifier, without bothering about such extraneous details as the method by which bias is obtained. There is a tuned circuit in the plate, and across it a

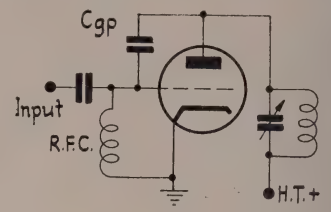


Fig. 1

large R.F. voltage is developed. A small amount of this voltage is fed back to the grid through the grid plate capacity, which we have drawn in Fig. 1 as an actual condenser, whose capacity will be between 1 and 10 $\mu\mu$fd., for most tube types. Now at radio frequencies, these small capacities have quite low reactances, so that it is possible for quite a large proportion of the R.F. plate voltage to be delivered back to the grid through the grid-plate capacity, and it is this fact, among others, which makes regeneration possible. Now, given that feedback from plate to grid can occur, it only remains to be seen what features of the circuit can cause the feedback to be either negative or positive. If a feedback voltage is present, all that determines whether the feedback is positive or negative is the phase relation between the signal voltage actually applied to the grid by the driving stage, and the R.F. voltage fed back to the grid by the plate circuit. At the resonant frequency of the tuned plate circuit, the phase of the voltage fed back is 180° different from that of the input signal, so that at this frequency, any feedback is negative, and results in loss of amplification. However, at frequencies on one side of resonance, the tuned circuit itself causes an additional phase shift in such a direction that there is a component of feedback voltage that is in phase with the input voltage. This is regeneration and if the in-phase component of feedback voltage is great enough, oscillation will take place. An important point about the oscillation, when it occurs, is that it is not exactly at the frequency to which the plate circuit is tuned, but slightly lower. Thus, if neutralization is partially successful, one of the things that can happen is that oscillation takes place at some slightly lower frequency than the carrier, but only when the valve amplification is high. This means at that part of the R.F. input cycle which drives the grid positive. In both CW and 'phone transmitters, intermittent oscillation like this can be very difficult to detect, and it shows up only as a roughness attached to the signal proper. In the CW case, it will detract from the cleanness of the note, and on 'phone it will be apparent as a spurious sideband—

or a series of them, making the space taken up by the transmission much greater than it should be.

So much for a quick explanation of the effects of grid-plate feedback. What is required is a method of eliminating them, and this in turn means that the feedback itself must be prevented from occurring. Perhaps the easiest method to visualize is one which is hardly ever used in amateur practice, but which is very popular in commercially-built transmitters, especially those intended for fixed-frequency operation. This is usually known as inductive neutralization, or more simply as coil neutralization. It should be more used than it is, because it can result in much better neutralization than is obtained by commoner means, and at V.H.F., it is undoubtedly the best method to use, bar none. It is illustrated in Fig. 2, in which the condenser C is merely a large blocking condenser whose only job is to prevent the plate voltage from being applied to the grid, and which plays no part in the neutralization. The inductance L_n is made of such a size that it resonates with the grid-plate capacity of the tube, forming with it a Parallel-tuned circuit at the operating frequency, Now at the tuned frequency, a parallel-tuned circuit looks to the signal just like a resistance of very high value so that the addition of the coil has placed such a resistance in the feedback path between plate and grid, thus reducing the degree of feedback to negligible proportions. When the grid of the amplifier is being driven positive, the impedance between grid and ground is quite low, so that the voltage divider formed by the effective impedance of the tuned neutralizing circuit and the grid input impedance has a very high ratio, which allows only a very small fraction of the output voltage to be fed back. This circuit is very easily adjusted with the aid of a V.T. voltmeter in the following way. The plate connection to the tank circuit is broken at the point x, and the voltmeter is connected between plate and earth. Then with the cathode or heater of the valve hot, and drive applied, the following steps are taken: First the grid circuit is tuned to resonance, if the stage has its own tuning circuit. If it has not, as when capacity coupling is used, the plate tank of the previous stage is carefully tuned to resonance at the signal frequency. This can be judged either as the point of maximum grid current in the stage being neutralized, or as **maximum** reading in the V.T. voltmeter attached to the plate circuit. This done, the inductance of the neutralizing coil is adjusted for minimum reading on the V.T.V.M. When this has been done, neutralization is complete. Reconnecting the plate tank will have no effect on the neutralization, nor will the tuning of the plate tank.

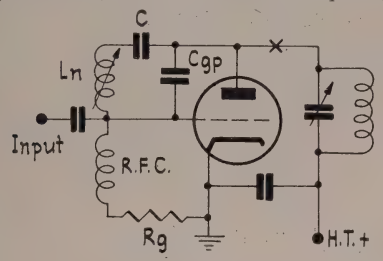


Fig. 2

It might well be asked why it is that this system of neutralization is not more popular, if it is so easily adjusted. The answer is two-fold. In the first place, it requires adjustment even for relatively small changes in signal frequency. In this it is unlike the common plate-neutralizing scheme that almost everybody uses, for the latter system will hold over a wide range of frequencies once it is properly adjusted. Plate neutralization is effective on any band from 80 to 10 metres provided that the design of the stage is suitable for the highest frequency on which it is expected to work. An R.F. amplifier which has plug-in coils, or other method of band changing should always be neutralized on the highest band. If this is successfully accomplished, neutralization will almost always be satisfactory on all lower bands. Inductive neutralization, on the other hand, does need re-adjusting for almost any change in signal frequency, and usually requires a variable inductance of the roller-contact type. Such a neutralizing coil can be used on several bands, however. As the L/C ratio of the neutralizing circuit is much higher than in tank circuits, owing to the very small grid-plate capacity which acts as the tuning condenser, the coil used will always have a much higher inductance than the corresponding grid and plate tank coils. The difficulties associated with providing a continuously variable inductance can often be avoided by the simple expedient of increasing the grid-plate capacity of the tube artificially with a small variable condenser. This gives the convenience of adjustment associated with such a control, so that for each band, a plug-in neutralizing coil can be used. The only disadvantage of this modification to the basic system is that it is more frequency sensitive than when the variable condenser is not used. The variable should be as small as possible, so that the L/C ratio of the neutralizing circuit is still high. Since the frequency with which inductive neutralizing circuits need re-adjustment is greater than for most other systems, a built-in neutralizing indicator is very helpful, and a great time-saver. A good example of this is to be found in the circuit designed by Mr. D. C. Sutherland, ZL2AJL, and described in the April, 1956, issue of this journal.

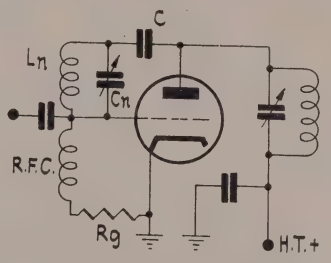


Fig. 3

A great advantage of the inductive system, which may even outweigh other considerations at times, is that a single-ended stage does not need a split-stator condenser in either grid or plate circuit. Above all, if you have difficulty in neutralizing any triode R.F. amplifier at 10 metres or higher, try the inductive scheme. It is ideal at V.H.F.

If used with a push-pull amplifier, each tube is treated separately, as there is no cross-connection, and the neutralization of each tube in no way depends on the characteristics of the other. Indeed, a success-

ful V.H.F. push-pull amplifier can be built on this system using tubes that are much more out of balance as to characteristics than is the case with other arrangements.

PLATE NEUTRALIZATION

This is the commonest of all neutralizing circuits. Like all except the inductive system, it is a bridge arrangement, which is composed of four capacities. When the bridge is balanced, the feedback from plate to grid is exactly balanced by an equal amount of feedback in opposite phase, through the neutralizing condenser. In this way, the nett result is as if there were no feedback at all, or as if the grid-plate capacity had been totally eliminated. In theory, this is very nice, for the balanced feedbacks depend only on the capacities in the circuit. In theory, these do not change, so that if the stage is neutralized for one frequency, it should be neutralized at all frequencies. However, making an R.F. amplifier behave in this ideal fashion is not always so easy, and the failure to do so accounts for many of the troubles we have mentioned earlier in this article. A typical plate-neutralized stage is shown in Fig. 4. A split-stator plate tank condenser is used, and its purpose is to act in two ways. First of all it is a phase inverter, for if any point on a tuned circuit, other than one end, is earthed, the R.F. voltages at the ends will always be 180° out of phase with each other. Its second purpose is to act as the ratio-arms of the bridge

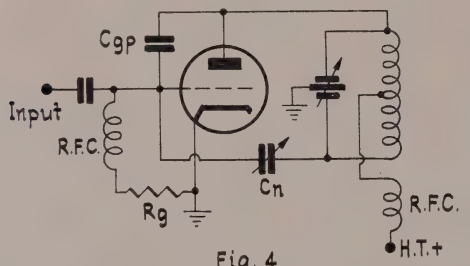


Fig. 4

circuit, aforementioned. Since the capacities of the halves of a split-stator condenser are always equal, irrespective of the setting of the condenser, the R.F. voltages at the ends of the circuit will be equal in magnitude as well as 180° out of phase. Thus, in order to balance the bridge, the neutralizing condenser must be connected from the grid to the opposite end of the tank circuit from the plate, and at the same time, the condenser must have a capacity equal to the grid-plate capacity of the tube. If we eliminate everything from the circuit except the bridge components, we arrive at the circuit of Fig. 5, which has been drawn to emphasize the bridge-like nature of the circuit.

All this is so simple and straight-forward that one might be forgiven for asking what there is about it, that can go wrong. The answer is that very little can go wrong with it provided that the circuit really does correspond with Fig. 5. It is the old story of hidden components again. Particularly at very high frequencies, leads have inductance, so that it is quite possible for the balance of the bridge to be thrown right out because of poor circuit lay-out or construction, although the wiring diagram may have been faithfully followed. Once the placement of the plate tank circuit has been decided upon, there is a certain length of lead from the tuned circuit to the plate cap on the valve, and this lead possesses a small amount of inductance, which the theoretical diagram conveniently ignores. It may well be, however, that the layout of parts makes the leads to and from the neutralizing con-

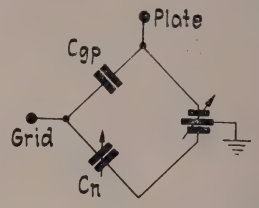


Fig. 5

denser much longer than the plate lead. If this is the case, we have a larger inductance in series with the neutralizing condenser than we have in series with the grid-plate capacity, and the bridge is no longer balanced. With such an arrangement, it may be possible to secure neutralization at the operating frequency that is of most interest, but this does not follow, and the stray lead inductances may render neutralization impossible. At the best, performance will be unsatisfactory, because the unbalance in the inductances will cause neutralization to be frequency-sensitive, whereas if the theoretical performance is obtained there is not the least frequency discrimination about it.

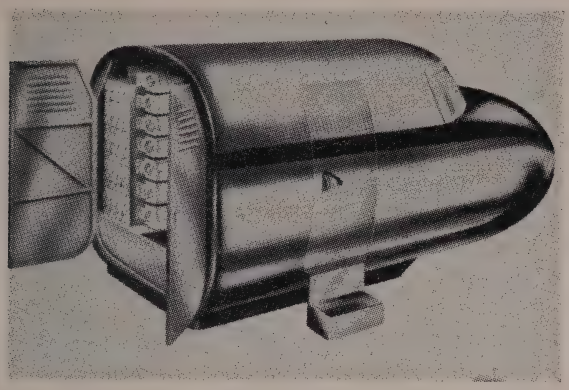
It is now possible to see, also, how it is that a lay-out may work quite normally at lower frequencies, and yet be unusable at higher ones. At 80 metres, for example, the stray lead inductances will be the same as they are at 10 metres, but at 80 their value will be so small compared with those of the tank circuits, that their effect will not be noticeable. At the higher frequency, however, these same inductances will be quite large in proportion to the intentional circuit inductances. Also, their reactances will be comparable with those of the grid-plate capacity and the neutralizing condenser, and when this is the case, neutralization is more likely to be impossible.

All this gives the reason why R.F. amplifier stages should be laid out with the utmost care, especially if they are to be multi-band or high-frequency affairs. It also explains why inductive neutralization is so effective at V.H.F. With it, the neutralizing coil can be connected directly between the grid and the plate pins or caps, so that there are virtually no leads at all to introduce stray inductance effects. Also the very fact that the system does not depend on balancing a bridge circuit stands to its favour.

And this in its turn brings out a further useful point. The system of neutralization used should often be chosen with regard to the physical construction of the tube used. Those whose envelopes are large, with the grid connection in the base, and the plate cap on top, are often unsuitable for H.F. or V.H.F. application in a particular circuit, simply because the considerations we have been mentioning cannot be taken if that circuit is used. In this connection it is most noticeable that the tendency in the design of

(Continued on page 43)

FLIGHT CREW TRAINING BY ELECTRONICS!



An impression of the complete trainer, with the computer and power supply rack inspection doors open.

High over the Irish Sea, a big transatlantic airliner noses its way through the wintry overcast. Some fifty minutes have elapsed since it took off from Shannon; in less than three hours it will touch down at Schipol.

In the warmth of their commodious "office" up front, the captain and first officer methodically scan their instruments. Outside, four powerful engines hum with mechanical contentment.

Suddenly, from London comes a weather report: "Storm area over the East of England and the North Sea."

The captain turns in his seat, leans down, and locks into position the display head of his storm warning radar. Sure enough, within an hour ominous patches of "white" light up the cathode-ray tube as the plane's radar pierces cloud and rain to reveal storm centres looming up directly ahead.

Almost imperceptibly the captain changes the plane's course five degrees to port. The pattern on the display tube clears, and the turbulent storm centres slip harmlessly by on either side.

Still surrounded by dense cloud formations, the captain takes a radio check on his position, and heads the airliner on the normal approach course.

Over the V.H.F. radio he obtains his instruction for the approach from air traffic control, reducing height slowly until over the airfield at 2,500 ft., whereupon he receives further clearance for the final approach and landing.

A quick change in the tuning of one of his A.D.F. receivers and he intercepts the ILS approach beam.

He requests that the undercarriage be lowered and that the engines are set at the appropriate powers. His colleagues comply with his request with quiet efficiency. Maintaining the heading indicated by the ILS beam, the captain is now guided through the darkness on his approach.

His requests for flap settings are met by the co-pilot. As the altimeter indicates his steadily decreasing height, the aircraft passes over a marker beacon. A warning lamp glows on the instrument panel, indicating the distance to the runway.

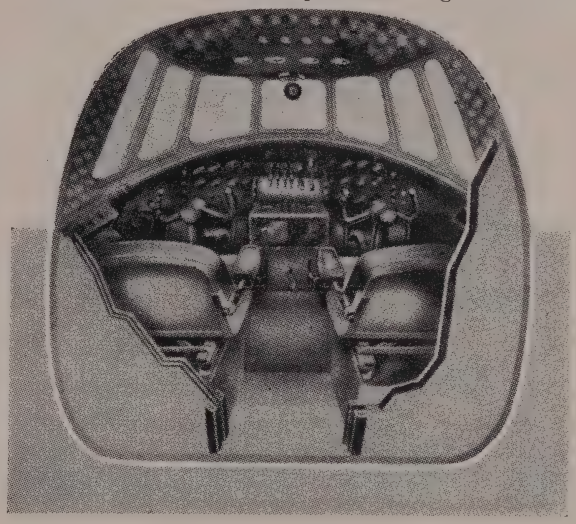
The captain eases back the control column to complete his approach with a gentle landing. Within seconds the steady hum of the engines rises to a crescendo as the pitch of the two inboard propellers is reversed to bring the aircraft to a standstill. Finally, the engines are brought to rest and another successful exercise in the Redifon Instrument Flight Trainer has been completed—under the close observation of an experienced instructor.

A WORLD'S FIRST

The "flight" from Shannon to Schipol has been routine in almost every way—apart, of course, from the truly astonishing fact that the crew had at no time left the ground, every detail of the flight being effected by the use of electronics!

Latest addition to Redifon's ever-increasing range of aircrew training aids, the equipment is the world's first electronic Procedure Trainer with a full-scale flight deck.

Representing a stage between the primary ground trainer and the more comprehensive flight simulator,



Flight deck of the Redifon trainer has been designed in such a way that its furnishings can be made to resemble that of virtually any modern "multi" or "twin."

the Redifon Procedure Trainer has been developed as the result of consultations between Redifon and the leading Commonwealth and European airlines.

SELF-CONTAINED

It has been designed on the one hand for operators whose economy will not permit the acquisition of a flight simulator, and, on the other, for the airlines owning a mixed fleet of aircraft. Compact and completely self-contained, the Procedure Trainer has been designed so that it can be supplied to meet a requirement for the effect of a twin or multi-engined aircraft.

The trainer provides for the crew to be taught to operate the machine by instruments, allowing them to see the effects of their control movements and interpret the machine's attitude and performance from the various readings.

RECORD TALK

by JOHN GRAY

Festival have now announced their plans for distribution of the American Decca catalogue, and the first two release sheets, issued through G. A. Woolley & Co. Ltd., who are continuing as New Zealand agents, show that they have dipped rewardingly into the vast mass of available material. The novelty of the occasion is the already famous "Singing Dogs" record (SP45-819), on which those astute canines can be heard barking their way through "Three Blind Mice" and other tunes. The record is irresistibly funny and is a must for the younger set. Argument as to whether the dogs really perform, as claimed, or do so by the help of numerous tape splicings, has no bearing whatever on the ultimate result. Another 45 due for heavy sales is the Bill Haley coupling, "Burn That Candle" and "Rock a Beatin' Boogie" (SP45-807), while in the extended play category are four numbers from the "Guys and Dolls" sound-track, wherein Marlon Brando and Jean Simmons make their eagerly awaited debuts as singers (XP45-805).

Miklos Gafni, the Hungarian tenor who is now back with us, made a record just before leaving America. It is of arias from well known Italian operas and will obviously be in great demand (FR10-845). "Tosca", "Pagliacci" and "Cavalleria Rusticana" are among the works represented. Among the popular LPs, the attraction will undoubtedly be the sound track from the "Benny Goodman Story", released here with commendable speed on FR12-831 and 850 (4 sides). Festival wisely urge us to "Beware of imitations", for this is the actual material as played in the film, and every other company for which Goodman has recorded in his long and busy career will doubtless be brushing the dust off their own masters. Bing Crosby, Burl Ives, Louis Armstrong, Sonny Burke, and Jack Pleis are some of the many artists represented in a truly bumper release. On the more serious side, a number of Vox records are made available, including a powerful performance of the Brahms D minor concerto, which work, by the way, is also featured by HMV this month. The Vox is by the great Viennese pianist, Friedrich Wuhrer, and was described by an English reviewer as being "tremendous Brahms" (APL8000). Wuhrer is also the soloist in Beethoven's unimportant but fascinating "Choral Fantasia", an enjoyable work for piano, chorus and orchestra which sounds like just what it was—a preliminary sketch for the ninth symphony. It shares APL6480 with Schubert's "Song of the Spirits over the Water" for chorus and orchestra, and both works are conducted by Clemens Krauss.

Tanza are now well into their stride with home-grown versions of big overseas hits, and there will be general satisfaction over Mary Feeney's "Teen Age Prayer" which, despite its name, is not a "religious" number. Its backing on Z277 is "I'll Come When You Call". Pat McMinn gives us versions of "Twenty Tiny Fingers" and "I Hear You Knockin'" (Z280), while the Dorothy Brannigan-Buster Keane combination is equally up to date with "Love and Marriage" and "The Kentuckian" (Z269). Finally there are the Gedson Sisters, who have sure-fire material in "Daddy-O" and "Rock and Roll Waltz" (Z272). Thus Radio Corporation, without the benefit of an overseas label at the moment, are nevertheless able to offer recordings of all the major hit numbers—a situation which bears witness to their enterprise and their admirable faith in New Zealand talent.

Some of the most tasteful of the lighter LPs have always come from Radiola-Telefunken, and LA6012, a melange by Max Greger's dance orchestra, carries on this pleasant tradition. Among the eight melodious foxtrots we note that old timer, "I Kiss Your Hand, Madame". Also highlighted in Radiola's release are two jazz records, one of which features the accomplished alto saxophonist, Bruce Turner, and the other has Chris Barber's Jazz Band in eight numbers (LA5008). It is a far cry from all this to the one classical item on the list—Bach's third suite for unaccompanied 'cello! The player is Edmond Bayens, and the number LB6059.

Philips have that amusing combination, Somethin' Smith and the Redheads, giving new treatment to the familiar "Pretty Baby", and as a backing on B21723 they have secured a new Bob Merrill number called "When All the Streets are Dark". The Four Coins are well within the rock and roll territory with "My Anxious Heart", and by the way of contrast its companion, "Oh Mother Dear", is in Neapolitan style complete with the expected guitars (B21661). There is a whole crop of Western releases by stars familiar and unfamiliar; perhaps the most amusing is the coupling by one Carl Story on B24583, because the lyrics of these numbers have a tongue-in-cheek flavour, and cowboys are much more enjoyable being facetious than being serious! At any rate you should hear these numbers "What a Line" and "You've Been Tom Cattin' Around", after which you should be more able to face up to Ted Daffan's Texans, who claim our sympathy with "No Letter Today" and "Born to Lose" on B24568. The rock and roll craze has even invaded Western territory as well, as witness Eddie Zack's "I'm Gonna Roll and Rock" (B24573).

With their first LP release of the year Philips have boldly entered the lists with a Mozart recording which will rank as one of the most distinguished of the present flood: their Vienna version of "Don Giovanni", with a stellar cast under the dramatic direction of Rudolf Moralt. The issue is most handsomely packaged and, like the HMV Glyndebourne reissue, the whole of this very long opera has been accommodated on only three records (ABL3069-71). The rival Decca set, which may be expected soon, covers the same ground, musically, but takes a whole extra disc to do it. Philips has much more than compactness as a recommendation, for the performance is exemplary and Sena Jurinac's Donna Elvira could probably not be bettered anywhere today. Here is a performance worthy to rank alongside Columbia's recent "Cosi fan Tutte". The Philadelphia Orchestra are heard in two very different new releases. On ABL3061 is a blazing performance of Strauss's "Ein Heldenleben", on the lesser-priced NBL5019 we are in more placid waters with that most beloved of all ballets, "Les Sylphides", which shares the record with the sparkling Offenbach "Gaiete Parisienne". An extraordinary memento of one of the greatest interpretative artists of our time is Pablo Casals' performance of Schumann's 'cello concerto on ABR4035. Despite his advanced age the old master's command of his instrument is as great as ever, and one is either deeply moved or faintly irritated by the deep moans and groans which now accompany his playing! The orchestra is that of his Prades Festival, and, although no conductor is mentioned on the label, it is known that the Festival performances were conducted by Eugene Ormandy. There is a very well made disc of highlights from Verdi's opera "Othello", which is just the thing for admirers of that opera who nevertheless are not disposed to invest in a complete recording. The singers are Ramon Vinay, Eleanor Steber and Frank Guarrera, with the Metropolitan Opera Orchestra, and many of the most thrilling pages of the score are contained on ABL3005. The Metropolitan also provides the latest release of "Cavalleria Rusticana" (ABR 4000-1, an economic arrangement of two 10-inch discs), in which the three main leads are Margaret Harshaw, Richard Tucker, and Guarrera. Some lighter offerings round off this attractive Philips list—a further Johann Strauss collection by the Vienna Symphony Orchestra (NBR6022) offers once again some unfamiliar waltzes, polkas, and mazurkas, and there are discs of Latin abandon (Xavier Cugat, BBL7038) theme songs from Hollywood films (Paul Weston and his Orchestra, BBL7039), and an attractive Australian collection of "Kindergarten Stories" engagingly told by Ruth Fenner. These have been adapted from a series of ABC broadcasts, and are a welcome addition to the small amount of worthwhile children's material (BBR8043).

There is a quite a crop of bright numbers going the rounds at the moment. Tunes like "Love and Marriage", "Lisbon Antigua" and "Robin Hood" are well calculated to set people whistling or humming and their feet tapping. Frank Sinatra makes the very most of "Love and Marriage" (Capitol 3260), and the other two tunes are happily combined by Nelson Riddle on 3287. In more bouncy strain are "At My Front Door" (Pat Boone, London NZL102) and the fast-moving "Daddy-O". This latter is done by the irrepressible Bonnie Lou on Parlophone NZP31 and is backed by the tall girl's lament, "Dancing in my Socks"; the other version of "Daddy-O" is by the Fontaine Sisters on HL8211. Another of those old tunes which periodically emerge from the obscurity they have endured for so long is a piece called in some versions "Moritat" and in others referred to simply as the "Theme from the Threepenny Opera". This opus, first produced in Berlin in the late 1920s, was loosely based on the famous "Beggar's Opera", with the story transferred to the rather down-at-heel Germany of that time; the music was by Kurt Weill of "September Song" and "Lady in the Dark" fame, a composer who consistently kept one foot in both musical worlds. As so often happens after a space of years, "The Threepenny Opera" is now enjoying a revival and this tune has emerged as something in the nature of a hit. The first version to reach our lists is put out on Capitol under the title "Moritat", and it is hauntingly played by Les Paul (3329)—reverse piece, "Nuevo Laredo" also shows signs of attaining popularity.

Mario Lanza is back in favour: a new film is due before long and an upsurge of interest in his discs is confidently to be expected. Let the critics rail as they will, it cannot be denied that Lanza has what really counts in the long run: voice, voice, and still more voice. "Begin the Beguine" and "Night and Day" are coupled on DA 30500, "Siboney" and "Valencia" on DA 30501, both in the red label HMV series.

HMV have continued their Gilbert and Sullivan revivals with the production of a two-disc set incorporating the D'Oyly Carte performances of "H.M.S. Pinafore" and "Trial by Jury", which have often made an attractive double bill in the theatre (ALP 1293-4). Once again it must be pointed out that these recordings are over a quarter of a century old, and we may be excused for wondering whether it is really fair that they should still be issued in the red label category. Maybe the price is not too high for the polished and (in the best sense of the word) the aristocratic singing of people like George Baker, for the priceless characterization of Leo Sheffield as the Judge, and the classic performance of Henry Lytton as the Ruler of the Queen's Navee. Further memories of the same period are evoked by a disc entitled "Homage to Pavlova" (ALP1301) in which Efrem Kurtz leads the Philharmonia Orchestra through some of the music associated with that greatest of all dancers, who died in 1931. She visited New Zealand with her company in the late nineteen-twenties, long before ballet became a regular feature of our theatrical life, and there are many who would say that we have since seen no one who can remotely be compared with her. It is to them that this new record, with its Chopin and Tchaikovsky snippets, and its beautiful playing of "The Swan", that Saint Saens fragment which Pavlova made forever her own, will be most precious.

In these days when almost all standard works are available in anything up to half a dozen different versions, I feel it is both unwise and dangerous to state dogmatically that such and such an issue is "the best". Yet this is what people seem to want, and it cannot be too strongly emphasized that personal taste looms large here, where any claim as to superiority is far more a matter of opinion than of fact. This is a roundabout way of saying that the new version of the "Emperor" Concerto played by Solomon and the Philharmonia under Herbert Menges (ALP1300) seems to me the version to have. There will doubtless be others to advance the claims of Fischer, Gieseking, Backhaus and Cor de Groot, especially as there is not a really poor recording among them. And those who have not yet added one of the many excellent versions of the Brahms piano concerto in D minor should certainly consider the new HMV by Rubinstein and the Chicago Symphony Orchestra under Fritz Reiner on ALP1297. There is a further selection of Schubert songs from the supremely gifted baritone Fischer-Dieskau, with Gerald Moore in support as usual. "The Winter Journey" is complete on three sides (ALP1298-9) and a miscellaneous group on ALP1295 contains some of the more rarely heard songs. In the orchestral sphere, HMV have Tchaikovsky's "Nutcracker" Suite, coupled this time with the pithy and arresting music from Prokofieff's opera "The Love of Three Oranges" (Philharmonia under Nikolai Malko, CLP1060).

Columbia have more opera for us: a first appearance of Gounod's "Mireille", a tuneful work given all over France as a repertory piece but a decided rarity elsewhere. Janine Vivalda and Nicolai Gedda head the cast of this production, recorded in connection with the festival at Aix en Provence, where the opera was given in the awe-inspiring open air setting which was the locale of the original story (33CX 1299-1301). We are on much more familiar ground when it comes to the latest "Madame Butterfly" (33CX 1296-8), one of the long line of La Scala recordings featuring the versatile Maria Callas, and conducted by Herbert von Karajan. Perhaps one of the still unrepresented Verdi operas would have been more useful, and many will already have bought the very touching Rome Opera recording featuring Victoria de los Angeles. But care has been lavished on a brilliant and moving performance. Of great interest is the new "Die Fledermaus" (33CX 1309-10) for the marvellously performed Decca set had been accepted as a classic version of this score. I really think it must now be dethroned. The Decca had an incomparable Viennese lilt and atmosphere, but recording has advanced since its release and this new Columbia is altogether cleaner and brighter in sound. Moreover, the inclusion of a sprinkling of dialogue does suggest a performance rather than just a chain of "numbers". Elisabeth Schwarzkopf and Rita Streich, as Rosalinde and Adele, easily out-sing their Decca rivals. The orchestral playing (British, not native Viennese, for the Philharmonia is once again in attendance, with Karajan directing), may justly be called wonderful.

In the case of Sir William Walton's "Troilus and Cressida" it was probably wise of Columbia to issue a disc of "highlights" rather than to embark on a full length recording. Some of the most striking and beautiful passages in the score have been assembled on 33CX 1313, in a performance directed by the composer, with Elisabeth Schwarzkopf and Richard Lewis as the ill-starred lovers. Judged as sheer music (as all recorded opera must be) this impresses me as being among the most truly satisfying of modern operas. The remainder of Columbia's list has a further instalment of Gieseking's definitive recordings of Debussy's piano music—the second book of Preludes is complete on 33CX 1304; while the brilliant young Geza Anda plays Beethoven's first piano concerto, adding the "Moonlight" sonata for good measure, on 33CX 1302. The conductor in the concerto is Alceo Galliera.

A Mozartian curiosity emerges with the issue of Tchaikovsky's "Mozartiana" Suite (Parlophone PMC1028). The Russian composer has simply taken four Mozart compositions and scored them for orchestra. Three were originally for piano, but for the fourth he has not hesitated to lay hands on, of all things, the Ave Verum Corpus! Perhaps this is one reason why critics look down their noses at the suite, which is not without its interest. On the reverse is a suite from one of Tchaikovsky's operas, which has the distinction of being known by at least four different titles—here it is called "The Slippers". The orchestra is the Philharmonia under Anatole Fistoulari.

The month's classics from English Decca are deserving of close attention, as usual. LXT 5082, which features Ernest Ansermet and the Paris Conservatoire Orchestra in Rimsky Korsakoff's "Scheherazade", should not be passed over as an old disc re-issued. As a matter of fact, this is a brand new performance, which supersedes the old issue on LXT 2508, and deserves its place, I think, as the outstanding interpretation on records of this voluptuous and exciting music. Anthony Collins completes his set of the Sibelius symphonies. The fifth is on LXT 5083, which it shares with "Night Ride and Sunrise", a piece, more obviously descriptive than most of Sibelius's programme music, which has not been obtainable since the old "Sibelius Society" days. Similarly the sixth symphony, released on LXT 5084, is coupled with a selection from the incidental music Sibelius wrote for Maeterlinck's play "Pelleas et Melisande".

Decca's Mozart festival offers this month two of the operas —"Figaro" and "The Magic Flute". The former, is conducted by the late Erich Kleiber, who has assembled a splendid cast mostly of Vienna Opera people, but including two native Italians, Cesare Siepi in the title role and Fernando Corena as Dr. Bartolo. The opera is of course sung in Italian and every bar of it is included in these four discs (LXT 5088-91). The "Flute" is, as usual, without any connecting dialogue, and another fine Vienna cast is here conducted by Karl Bohm (LXT 5085-7). As a recording, it is probably the best of the three "Flutes" at present available. Two instrumental discs are also worthy of notice; there is a splendid, quite unfamiliar orchestral serenade (No. 4 in D major, K203) played by the New Symphony under Peter Maag on LXT5074, and two violin concertos, those in D major and A major, are done by the veteran Mischa Elman, soon to be heard in a New Zealand tour. Elman's way of playing Mozart is not that of the present generation: there is sweetness of tone, but little else (LXT5078). The orchestra is the New Symphony under Joseph Krips.

LATEST OVERSEAS DEVELOPMENTS

BAIRD TRANSISTORIZED MIXER-AMPLIFIER

Baird Associates, Inc., Cambridge, Mass., U.S.A., have just released a portable transistorized mixer-amplifier. This compact, self-contained unit is 90 per cent lighter in weight and 95 per cent smaller than other known instruments of this type.

With a frequency response within 3 decibels from 100—10,000 cycles, this device is specially recommended for such field applications as remote-pickup recordings and interviews as well as in conjunction with outside public-address systems. Standard 600-ohm output impedance, balanced or unbalanced, permits direct coupling to telephone lines, tape recorders and other instruments or systems. Minimum distortion is assured through use of advanced circuit techniques.

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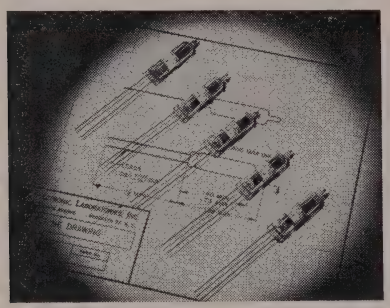

A complete line of miniature and sub-miniature fixed and adjustable corona discharge voltage regulator tubes is now available from Anton Electronic Laboratories, Inc., Brooklyn, N.Y., U.S.A.

These tubes are especially suited for stabilization of voltages from 300 v.–30 kv. at currents below several milliamperes. When required, voltage tolerances can be kept to within plus or minus 1%. All tubes are constructed for operation within the temperature range of minus 55–plus 75°C. Total change in regulated voltage for tubes below 4000 volts over this temperature range is about 1% of the operating voltage. For higher voltage tubes, this total change is considerably less.

Anton's exclusive "Varijust" design is available immediately in the 650–800 v. range and can be made available for other voltage ranges in large quantities. In the Varijust tube, a bellows and drive mechanism is added to permit variation of gas pressure in the tube, resulting in a smoothly adjustable regulated voltage. This makes the tubes particularly valuable in applications where high voltages supplied to a detector must be adjusted for limited changes in circuit characteristics which frequently accompany normal operation and life. Anton will supply, on request, Varijust regulator tubes which can be actuated for millions of cycles. All models are available either as fixed (non-adjustable) or adjustable as described above. The Anton organization, sole licensees under basic patents for manufacture of the corona regulator tubes, has carried out much of the basic research and development work done in this field.

When used within their ratings, the Anton regulator tubes will not exhibit delayed starting under any conditions of environment or after prolonged storage periods. Frequently, tubes installed in light-tight containers will not fire properly, or will exhibit delays in starting, even when exposed to light. Anton tubes are entirely free of this operating deficiency due to a unique engineering advancement which has been incorporated in each unit. A minute trace of radio-active emitter is introduced into the tube during manufacture which, according to the company, completely does away with erratic starting.

These rugged, long-lived tubes are recommended for a wide range of applications, including use in stabilization of power supplies in Geiger and scintillation counter radiac survey units; as voltage reference tubes and in control of high voltage and accelerating potentials of cathode-ray beam devices. The company reports its tubes have shown a higher degree of stabilization during operation than that obtainable through electronic regulating circuits.

From an economic standpoint, the Anton tubes compare favourably with conventional vacuum tube voltage regulating systems. Fewer tubes are required to achieve equal degrees of regulation, and attendant decrease in circuit complexity through use of corona tubes makes equipment more reliable.

Since corona discharge voltage regulator tubes are cold cathode devices, no filament or heater power is necessary. Reduction in heater power requirements also brings about smaller, lighter power supply transformers. Power dissipation is much less in corona regulators than in vacuum tubes, and this factor, coupled with saving in heater power, means less overall heat dissipation, permitting a high level of packaging efficiency in design of electronic equipment.

For additional information on the Anton line of corona discharge voltage regulator tubes, write Anton Electronic Laboratories, Inc., 1226 Flushing Avenue, Brooklyn, 37, N.Y.

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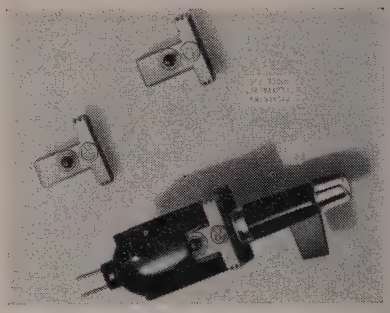
PICKERING MODEL 350 "FLUXVALVE" MAGNETIC PICKUP



A newly designed magnetic pickup cartridge, providing very wide range (VWR) is now in full production by Pickering and Company, manufacturers of professional audio components. The new model 350 "Fluxvalve" offers performance heretofore unattained by conventional pickups. Some of the outstanding features of Model No. 350 are:

1. Low tracking force, 2–6 grams, depending on arm used and record levels. (With 190D Pickering Arm on micro-groove records, required tracking force may be as low as 2–3 grams at normal recording levels).

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Available with diamond styli (350DD) or with diamond microgroove stylus and sapphire standard groove stylus (350DS).

Further details are available from Pickering & Co., Export Dept., 89 Broad Street, New York 4, N.Y, U.S.A.

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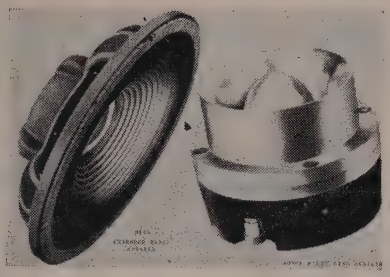
SIGNATURE MODEL 002

Announcement of a new kit for the high fidelity market has just been made by James B. Lansing Sound, Inc. The kit, called Signature Model 002, consists of the 075 Ring Radiator, the D123 Speaker and the N2500 dividing network.

The 075 is a high frequency unit which utilizes the principle of the ring radiator. In place of a conventional dome-shaped



diaphragm, a narrow aluminium ring radiates into the annular (rather than the tubular) opening of an exponentially tapered horn. All of the radiating surface is at the throat of the horn, thereby eliminating phase disturbance and, at the same time, eliminating the necessity for an expensive, precision-machined phasing plug. From its crossover region at 2500 cycles and on up, the 075 is a well designed, perfectly built precision transducer, at a moderate cost.

The 075 mates very well with the D123. This is a 12 in. unit made with a 3 in. edge-wound aluminium ribbon voice coil, and a frame of unique new design which gives it a very shallow configuration. The D123 is, in fact, just 3⅝ in. deep. This makes it the only speaker which can be mounted between studding, flush with any standard wall or partition. This is but one application. The D123 is a thoroughly excellent precision transducer with a usable frequency response range of from 30 to 15,000 c.p.s. when enclosed in an adequate baffle as a direct radiator.

The D123 may be used singly, or in multiples, or as a low frequency unit in a divided network system. The new 075 is a natural partner for the D123. Together they give clean, brilliant coverage of the audio spectrum. These units, together with dividing network number N2500, are now available in this new kit form—Signature Model 002.

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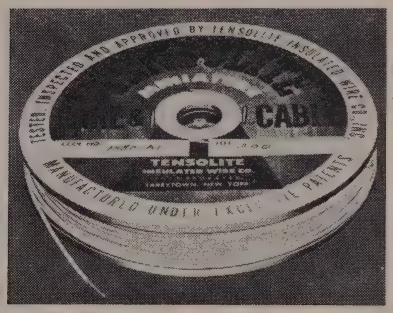

The special, exclusive, patented parallel-wrapping process, used in this Teflon (R) insulated miniature hookup wire results in a highly flexible product. Like all other Teflon (R) insulated wiring produced by Tensolite, Tensolon parallel-wrapped hookup wire offers ease and variety of application through the combination of minimum wall thickness with highest dielectric strength. This particular wiring is manufactured in accordance with MIL-W-16878B specifications for operating temperature range of —90° to +250° C.; is available in 14 solid colours; features free-stripping construction; as well as complete resistance to soldering and chemicals. Available in sizes 20 to 34 AWG.

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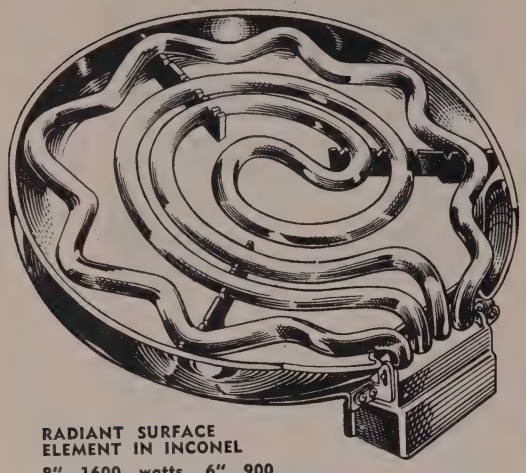

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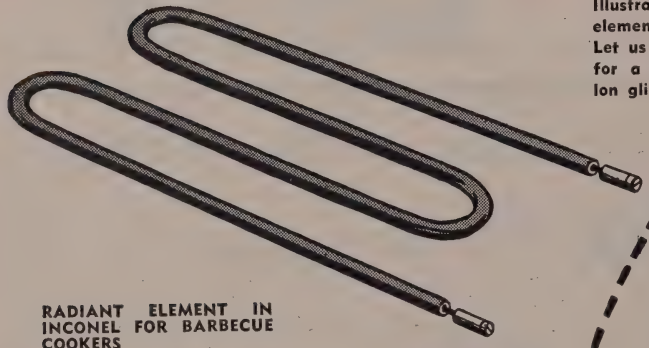

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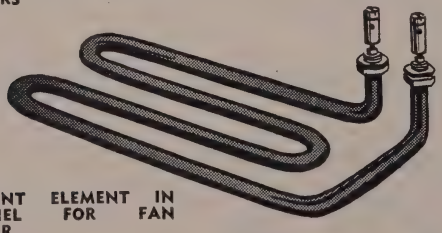

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ELECTRICAL AND TRADE SECTION

BELL AND ALARM SYSTEMS

Electric bell and alarm systems cover a wide and increasing field of application in domestic, and particularly in industrial installations where they are used not only just for calling attention, but for the location of staff who may be in any part of a large building or factory, for protection against burglary or other unauthorized entry, and for the detection of fire. Electric bells are also largely used as starting signals in public vehicles.

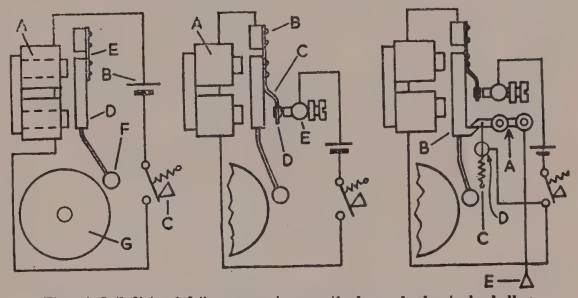
In the last application, the single-stroke bell is often used. This is the simplest type of bell and, as its name implies, gives one single stroke when the push is operated. The principle of the single-stroke bell is shown in Fig. 1, where A is an electro-magnet connected to the battery B through the push C, the contacts of which are normally open but are closed when pressure is applied. When the magnet is energized, the armature D is attracted against the pull of the spring E, and the hammer F strikes the gong G a resounding blow. The hammer is so arranged that it falls back slightly, after hitting the gong, thus permitting a clear ring to be obtained.

A popular application of the single-stroke bell is the chime consisting, in the Morphy-Richards design, of two tubular gongs between which is a hammer, working horizontally, and forming part of the plunger of a solenoid. When the push is depressed, the hammer is drawn to the right against the pressure of a spring and hits the right-hand gong. When the push is released, the hammer flies back beyond the normal position and strikes the left-hand tube. The tubes, being of different lengths, emit different tones.

Provision is made for a second push circuit. A resistance is included to limit the current so that the solenoid fails to attract the hammer sufficiently for it to strike the right-hand tube. It still strikes the left-hand tube on release of the push. This single-note signal enables one to tell which push has been pressed.

In most installations, a bell is required to ring continuously as long as the push is pressed. This is achieved by arranging the bell in the manner shown in Fig. 2, where one end of the magnet winding A is connected to the pivot of the armature B. On the armature is a spring blade C carrying contact D. In the "at rest" position the latter touches the adjustable contact E from which a connection to the battery is taken. It will be seen that when the magnet is energized through depression of the push, the contacts D and E separate and break the circuit with the result that the magnet is de-energized, the armature falls back, the points reclose and the process is repeated rapidly and continuously as long as the push remains pressed. This is the most common form of electric bell.

In some applications it is desirable that once a bell has been set in action, it should continue to ring until stopped by the person called. This is done



Figs. 1–3 (left to right) represent respectively, a single-stroke bell, a normal push-and-ring bell, and a type that continues to ring even when push is released.

by arranging a switch on the bell itself, connected in parallel with the caller's push, which is tripped immediately the armature is attracted. This is shown diagrammatically in Fig. 3, where the general arrangement of the bell is as in the previous figures. A is a pivoted lever normally resting on the projection B of the armature. When the bell rings the armature is drawn forward and the front end of A immediately falls down, by the pull of spring C and touches the insulated contact D. This action serves to short circuit the main push. The bell is silenced and reset by pulling cord E.

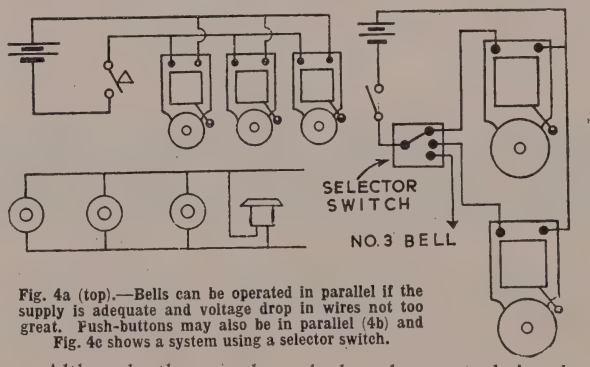


Fig. 4a (top).—Bells can be operated in parallel if the supply is adequate and voltage drop in wires not too great. Push-buttons may also be in parallel (4b) and Fig. 4c shows a system using a selector switch.

Although the word push has been used in the foregoing, it will be appreciated that any convenient form of switch may be used, such as a contact operated by a door or one set into the floor so that anyone stepping on a mat placed over it causes the bell to ring.

When warning is wanted at more than one point, several bells may be connected in parallel, see Fig. 4 (a). Similarly, where it is desired to operate a bell from several points, a number of pushes or contacts may also be connected in parallel, see Fig. 4 (b). Any one of several bells or pushes may be brought into circuit by means of a selector switch Fig. 4 (c), or the number of bells or switches in

parallel may be varied by means of switches in the individual circuits.

The rate of vibration of a bell is controlled by the setting of the contact points. The adjusting screw is fitted with a locking nut and care should be taken to ensure that this is tightened after an adjustment has been made. The vibration set up by the armature soon causes an unlocked screw to move. If the gong is removed from an electric bell, the instrument becomes virtually a buzzer, the pitch of which depends on the contact screw setting.

BELL SIZES

Bells are rated by the size of the gong. Domestic bell gongs are usually 3 or 4 in. in diameter, but for industrial use, 6, 8, and 10-inch gongs are available —with, of course, movements having the necessary greater power. Gongs are generally round, but other types, sheep, church, wire, and tubular, are also used. Each has its distinctive tone.

The operating voltage varies with the size and the nature of the application. Domestic bells run off 3 volts. Larger types may operate on 6, 12, or 24 volts or direct from a main supply. In general, bell circuits work on low voltage.

POWER SUPPLIES

For many years the Leclanche wet battery was used almost universally for operating bells, but it is rarely found today. The cell consists of a jar containing a solution of sal-ammoniac in water. Standing in the solution is a rod of zinc and a porous pot containing a carbon electrode packed tightly in place with a mixture of carbon powder and manganese dioxide.

The cell gives an open circuit voltage of about 1.6 and, in operation, the zinc wastes away and the solution becomes exhausted. These are the two items to be replenished when the battery becomes exhausted. The porous pot and its contents have an indefinite life. To obtain a greater voltage, more cells are connected in series.

So far as battery installations are concerned, the Leclanche cell has been replaced largely by the dry cell which is less messy, more reliable, has a long life and is simply replaced. Commercial bell installations are frequently operated from accumulators kept constantly charged from the mains through some form of rectifier.

Direct mains operated bell systems require that all the details of the installation are suitable for mains operation and installed as would be any other mains operated device. This expenditure is often unnecessary as low voltage operation is entirely satisfactory.

The most popular method of operating a bell system today is by means of a bell transformer having the primary connected permanently to the mains, the secondary giving the low voltage required for the bells. There are four sizes of bell transformers:

Class A 5-volt-amperes, i.e., 0.41 amp. at 12 volts.
10-volt-amperes, i.e., 0.83 amp. at 12 volts.
20-volt-amperes, i.e., 1.66 amp. at 12 volts.
Class B 6-volt-amperes, i.e., 1 amp. at 6 volts.

Class A transformers have a tapping in the output winding so arranged that 8 volts is obtained between the tapping and one end of the winding, and 4 volts between the tapping and the other end. Earth terminals and fuses are provided, and the specification calls for a 2,000-volts test from winding to earth.

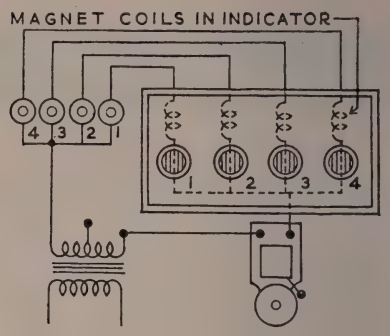


Fig. 5.—Mains operated system with an indicator board. The 'flags' may simply oscillate or need resetting by electrical or mechanical means.

Many special bells are made. For instance, the "all-in-one" carries its battery within the cover. A "two-in-one" contains both bell and buzzer, enabling calls from two points to be distinguished without use of an indicator.

Bells are also made with self-contained transformers in which case the mains supply is run to the bell terminals, but the bell itself and the outgoing leads to the push are low voltage. Weather-proof and certified flame-proof types are made.

Luminous pushes available for use with transformer-operated systems contain a small neon tube connected across the contacts which, when open, carry the full open circuit voltage of the transformer.

INDICATORS

When one bell is under the control of a number of different pushes, as in an hotel, generally it is necessary for the person called to know from where the call has originated. For this purpose an "indicator" is fitted and consists of a frame with a number of windows through which "flags" can be seen. Each flag is controlled by an electro-magnet in series with one of the leads from the push. An essential part is a means for resetting.

There are three main types of indicator movement in use, viz., pendulum, mechanical reset and electrical reset. The pendulum type is the simplest and cheapest. The flag just vibrates when the bell rings. The principal drawback, in a busy installation, is that the flag continues to vibrate for some time, and, if another call comes fairly quickly, it is difficult to know which one has been attended to.

In the mechanical indicator, passage of the current through the cell releases the flag which falls right away from the indicator window. A knob or pull chain is provided for resetting. In the electrical replacement type, the flag also falls away out of sight when the bell rings, but a second electro-magnet, controlled by a push near the indicator, is provided to reset the flag ready for the next signal. Figure 5 shows a typical indicator installation.

Although bells have been mentioned throughout the above description, buzzers or lamps may be used when the noise of a bell is not wanted. Where it is desired to set a large hooter or other mains-operated device in operation from the bell circuit, a relay is used with its coil in the bell system and the appara-

tus connected to the mains through the relay contacts.

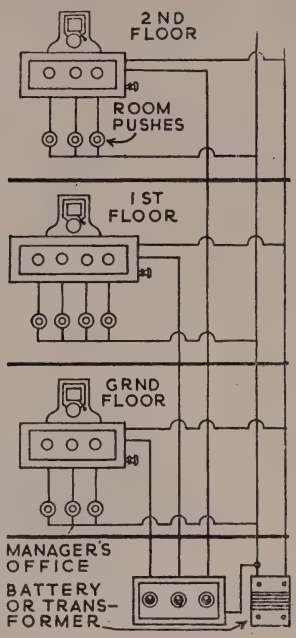
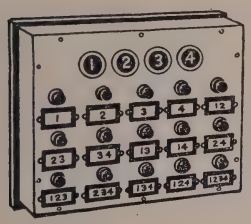


Fig. 6 (right).—Hotel system with a supervisory panel. Fig. 7 (below).—Control board of a light-system for staff location.



In hotels and similar places where the promptitude of attention to bell calls must be supervised, an additional master indicator can be fitted in the manager's office in the manner shown in Fig. 6. A lamp in the supervisory indicator glows whenever a bell is rung and continues to do so until the indicator is reset by the person called. In the installation shown, there is a lamp for each floor.

STAFF CALL SYSTEMS

One of the difficulties of management of a large works or institution is to locate key members of the staff who, in the course of their duties may be anywhere in the establishment. Where there is a system for relaying broadcast programmes, it is a simple matter to provide a microphone and broadcast for the person required. In a noisy works, or where calls are frequent, this system has its drawbacks and some form of light signal is often preferred.

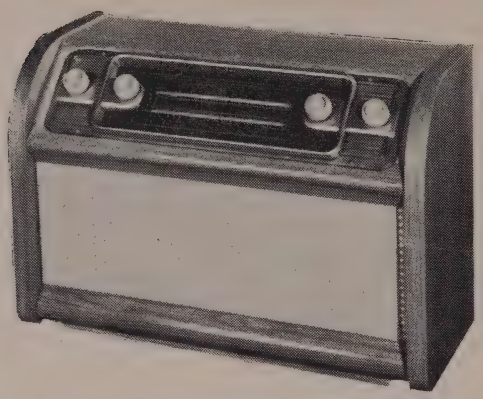
Various systems are available. In some, there is a set of different coloured lights at each calling station —say red, white, green and blue. Each executive is given a different combination, and on the central switchboard is a set of keys. To call any particular person it is necessary only to switch on the appropriate lights.

Fig. 7 shows a typical control switchboard where a combination of four differently coloured lamps or four translucent panels each having numbers 1. 2, 3, and 4 is used, each illuminated by a separate lamp. Fifteen different combinations are possible, as shown.

NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. For further particulars contact Advertising Manager, R. & E., Box 8022, Wellington.

"PLANNED TO PLEASE"



One thing about the Ultimate range of first-class radios, is that it is never static. Ever alive to the responsibility of presenting the latest and best in contemporary design, Messrs. Ultimate-Ekco (N.Z.) Co. Ltd., produce frequent new models. The latest is a 5-valve broadcast mantel in an oak cabinet—the "Stuart".

Built to the standards that have made Ultimate outstanding, the receiver is a quality product that will carry its brand name with pride, and give years of faithful service. An excellent tone is a feature of this set, and full provision has been made for plugging in a record-player and an extension speaker.

The cabinet features craftsmanship and fine polish enabling it to take a proud place in any home furnishing scheme. A new pattern grill cloth makes a pleasant contrast with the light or medium oak finish while the floodlit, crystal-front dial and modern knobs add the final touches to an appealing new mantel.

Planned to please both dealer and public alike, the "Stuart" is predicted to be a good seller.

Specifications:

Valves: 6BE6 Frequency Changer; EF51 I.F. Amplifier; 6AV6 2nd Detector; EL41 Power Amp.; 6X4 Rectifier.

Speaker: 6-9H Rola.

Dimensions: 18½ in. long; 12½ in. high; 8½ in. deep.
Price: £25 17s. 6d.

Manufactured and distributed by Messrs. Ultimate-Ekco (N.Z.) Co. Ltd., P.O. Box 1166, Auckland.

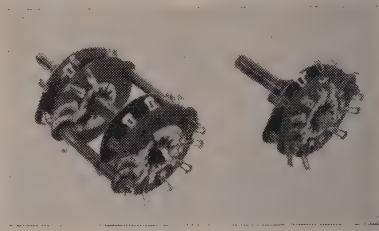
* * * *

NEW EUTRON RADIANT STOVE ELEMENT

Electric Utilities Co. Ltd., have for the past few months, featured their new type radiant stove element in this journal. This is the first time the manufacture of this type of element has been successfully undertaken in New Zealand. The quality and performance of these Eutron stove elements is comparable with the best overseas products and Electric Utilities Co. Ltd., have had the initiative to offer a range of elements to fit all makes of ranges, both old and new models. A new price list is now available to the trade and can be obtained from all wholesalers from whom stocks can be procured.

* * *

PLESSEY ROTARY SWITCHES



A rotary switch of advanced design which marks a new era in the field of multi-purpose switches is now being manufactured by the Plessey Company Limited, of England, and is available from Plessey International Ltd.,whose New Zealand representative for their range of radio and television components is William J. Blackwell, P.O. Box 1622, Auckland.

The new switch is known as the G.A.1, and its arrival solves many of the outstanding service problems encountered with switches in current use. Its robust construction represents a considerable advance on previous types, giving accurate control of manufacturing processes and new assembly methods and ensuring long life and reliable service.

The Plessey G.A.1 is a compact rotary wafer-type switch, and it can be constructed either as a single-wafer or multi-wafer unit with up to 12 positions. Each wafer permits up to 20 fully-insulated fixed contacts to be fitted. The contacts, which are of the double-wiping type, are fixed to the stator board by an entirely new method which ensures that the tags remain absolutely immobile under tangential pressure.

Outstanding features of the new switch include the use of special "Wedgelock" rivets which provide adequate lateral support and unusual tag strength. These rivets allow the whole design of the switch to be revised, and the tags can be mounted on the surface of the wafer instead of being supported by cut-away sections. A much stronger wafer results, and tags of the best possible shape can be used, thus providing more consistent contact with an effective self-cleaning action. In addition, the surface mounting of the tags permits the conventional rotor to be replaced by a strong rigid assembly with improved insulation resistance. These tags are mounted at an angle which enables separate sets of contacts to be placed on either side of the wafer without additional insulating members which weaken the structure and introduce additional electrical losses.

Repeated climatic and endurance tests, to stringent Government specifications, have proved that the Plessey G.A.1 switch can withstand the harshest treatment encountered in practical use. Every effort has been made to ensure that the potentialities of the new design have been realized in the actual construction of the switch, and materials have been carefullly selected to ensure that the switch is suitable for use under tropical conditions.

All inquiries should be directed to William J. Blackwell, P.O. Box 1622, Auckland.

* * * *

CLIPPER MODEL 616

The tuned R.F. stage incorporated in this new 6-valve Clipper model allows the listener to travel far afield in his search for entertainment, as well as ensuring perfect reception under normal circumstances. For the listener who wants Australian broadcoast stations with clarity, and for the man in the difficult reception area the Clipper 616 is the answer. Yet the 616 retails at only £29 19s. 6d.

The Clipper 616 is a 6-valve model with an 8-in. Celestion P.M. loudspeaker, and it is housed in a most distinctive walnut cabinet. The contrast between dial surround, fabric grille and the highly polished walnut of the cabinet is most attractive. Dimensions are 12½ in. x 16 in. x 17½ in. and the retail price of Clipper Model 616, only £29 19s. 6d. Price alone is enough to ensure ready sales.

Clipper radios are distributed throughout New Zealand by G. A. Wooller & Co. Ltd., head office, P.O. Box 2167, Auckland; branches at 43 Lower Taranaki Street, Wellington, and 16-18 Victoria Street, Christchurch.

Neutralizing Circuits

(Continued from page 32)

transmitting tubes is to make them smaller and smaller for a given plate dissipation. This is achieved by the use of modern constructional methods and materials, and the practice goes a long way towards making valves function better at higher frequencies than their old-fashioned counterparts would have done.

While on the subject of plate neutralization, there are one or two points worth mentioning. It often happens that one wants to use plate neutralization, but does not have a split-stator condenser available,

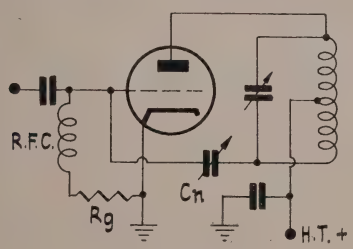


Fig. 6

and transmitters are often seen which use the circuit of Fig. 6. At first glance, this looks substantially the same as Fig. 5, but it is not, and its performance is decidely inferior. Here, a single-ended condenser is used and the tuned circuit is earthed at the centre of the coil instead. In theory, this scheme looks just as good as the other one, but it seldom works as well, especially at higher frequencies. One reason is that it is not possible to find the electrical centre of a coil as accurately as that of a split-stator condenser. Although the effect is no more than a slight shifting of the earth point from the centre of the circuit, which may be compensated by adjusting the neutralizing condenser so that it is no longer equal to the grid-plate capacity, it varies with frequency, so that one setting will no longer hold over a wide frequency range. And if plug-in coils are used, the neutralization will certainly need re-adjusting at every coil change. This in itself is not so much of a disadvantage, but the arrangement is inherently less well balanced than the other one, and so it is always found that with a given layout, the frequency at which proper neutralization becomes impossible is lower with this circuit than with others.

It should not be necessary to say so, but on no account should **both** the rotor of a split-stator condenser **and** the centre-tap of the tank coil be earthed. One sometimes finds this done in a misguided attempt to avoid the use of an R.F. choke in the H.T. lead, as is shown in Fig. 5. With series H.T. feed, the coil centre-tap is earthed by bypassing it to chassis, but if shunt feed is used, it may be directly connected to earth. When a split-stator condenser is used, the centre tap of the tank coil should always be fed through an R.F. choke. In this way, if the tap is not at the exact electrical centre of the coil, it does not matter, because the choke allows it to assume its natural R.F. potential, and at the same time prevents R.F. voltage from developing on the H.T. line.

Before leaving plate neutralization, the usual cross-neutralization of push-pull stages should be mentioned. This is simply a doubled-up version of the basic single-ended scheme. Here, balanced input and output circuits are needed for the push-pull tubes, quite apart from their neutralization, so that the only additional components are the neutralizing condensers. The push-pull circuit is often to be preferred, even if two valves are not needed to obtain their maximum power output, because it is rather easier to balance at all frequencies. Unfortunately, except for the double tetrodes, like the 815 and QQE06/40, it is not possible yet to buy right and left-handed versions of valves, so that perfect physical symmetry is not possible to obtain, but with any tube which has a plate cap, something very close to it can be obtained. Virtually perfect symmetry can be obtained with tubes like the HF100, which have grid caps on the side as well as plate caps on top, and it is very good practice to use such tubes even for medium-powered push-pull stages, because of the excellent circuit performance that can easily be obtained.

TRADE WINDS

PYE CHAIRMAN ON BRIEF VISIT TO NEW ZEALAND

Mr. C. O. Stanley, C.B.E., Chairman and Managing Director of Pye Limited, Cambridge, with Mr G. A. Wooller (right) who controls the Pye organization in Australia and New Zealand.

"I am flying back to Ireland from here, and I hope to see the Herefords and Shorthorns I'm exhibiting win the championship ribbons in the Spring Show in Dublin," said Mr C. O. Stanley, chairman and managing director of Pye, England, during a visit to Auckland in the course of a tour of Pye interests in Australia, New Zealand, and Egypt.

As chairman, Mr C. O. Stanley, C.B.E., not only controls the vast Pye companies but also has a wide diversity of interests in industry in England and Ireland. He describes himself as an English-Irishman because his people went to Ireland with Oliver Cromwell. "Who's Who" describes him as born in Lisselane, Clonakilty, Waterford, and educated at the famous Bishops Foy School, Waterford. He fought in World War I in the R.F.C. and was educated as a civil engineer. Mr C. O. Stanley successfully hides his undoubtedly brilliant mind and acute perceptive ability behind a quietly cheerful and unassuming manner. Interviewed in Mr George A. Wooller's office he was amusing and yet forthright in his ideas regarding his hobbies, farming and fishing. In spite of his many directorships and his responsibilities in the Pye group, Mr C. O. Stanley has large farming interests. These lie principally in the breeding of both dairy and beef cattle. His ideas on farming and stock breeding were far in advance of many of those held in Ireland at the moment, he said, and he lamented the lack of knowledge of the really efficient production and use of grass as it is known and practised in New Zealand. Also he admired the extreme efficiency of the sharemilking practices in this country and wished that Ireland had a similar method. He lived, he said, mainly on his property on the Duxfield Road between Cambridge and Newmarket and there tried to use certain methods of New Zealand grassland farming practice which experience had proved to be efficient and profitable.

Of big game fishing in New Zealand waters Mr C. O. Stanley had this to say: "I'm coming next year to fish with Mr Wooller and I hope to enjoy good sport; last year I caught a marlin and I might even catch another fish—at least I shall enjoy trying."

A cable just received from Dublin informs us that Mr C. O. Stanley won first prize with Lisselane Imperial Emperor in the Dairy Shorthorns yearling class, also two fourths and one reserve with his other animals. The Dublin Spring Show is of international character and standing and is ranked among the first six shows of its kind in the world. Animals successful in competition at this Show are considered in world class.

*

DRECO MANAGER VISITS PHILCO PLANT IN U.S.A.

Mr Trevor Gobby, manager of the Dominion Radio and Electrical Corporation Ltd., of Auckland, left by air on a business trip to America on 18th May. The greater part of his time is to be spent at Philco, Philadelphia, where top-level discussions will be held on a most progressive development plan for Philco in this country.

Philco's activities are extending overseas into all fields of electronics as well as that of the major home appliances. Their development laboratories have on loan to the American Defence Force in excess of 2,000 scientists who are engaged on developmental work on the highest level.

Philco's leadership in radio and television has made the development of the transistor a matter of major importance. In America today, Philco have on sale a complete range of fully transistorized receivers and have also entered the office calculating machine field with amazing results.

In Australia, Philco have plans for taking a major part in the industrial development of that country with most beneficial effects on New Zealand.

Mr Gobby will be away for several weeks, and considerable activity could eventuate from decisions made overseas.

*

MR D. P. LAVIN—NEW SALES MANAGER FOR RUSSELL IMPORT CO. LTD.

New sales manager for Russell Import Co. Ltd. is Mr Desmond Lavin, formerly New Zealand wholesale representative for a large company importing musical instruments.

Prior to service in the R.N.Z.A.F. in the Pacific theatre during World War II, Mr Lavin, a Wellingtonian and a member of the Chartered Institute of Secretaries, was accountant for the Wellington Investment Trustee and Agency Co. Ltd.

Interested in photography and music, Mr Lavin is widely known as a violinist of some distinction, having given many broadcast recitals and toured with the National Orchestra. With the growing public interest in high fidelity and record reproducers, and Russell Import Company's activities in this field, Mr Lavin's musical background and sound commercial experience will prove of immense value.

We join with Mr Lavin's wide circle of business and musical friends in congratulating him on his new

appointment and wishing him every success in this new sphere of activities.

* * *

"LA GLORIA" SUCCESS IN THE NORTH

Advice from the Dominion Radio and Electrical Corporation Ltd., reveals that, so terrific has been the demand for the "La Gloria" radiograms in the Auckland area that release of these sets in southern territories has had to be delayed.

Manufactured in eight cabinet styles and finishes in New Zealand's largest and most modern radio factory—the only one with a cabinet manufacturing division—La Gloria radiograms are being developed as a popular priced line, and the range will be progressively extended to include all types of radio receivers.

Despite the release date of "La Gloria" being mid-March and right in the middle of "end of the year", "income tax" and credit squeeze problems, dealers showed their enthusiastic support by buying the entire first run before completion. Within four weeks of the release of "La Gloria", 80% of all stockists had placed repeat orders. One Auckland suburban dealer sold 15 "La Gloria" consoles in 10 days—an all-time record for any type of radio sold in his store. Another sold more "La Gloria" consoles in two weeks than all other sets in any similar period, and a major city dealer, stocking all brands of receivers, has sold two "La Glorias" to one of all other consoles in the last month.

* * *

G.E.C. CHANGES A TRADE MARK

The General Electric Co. Ltd. of England announces an important change in one of its trademarks. Since April 2nd, 1956, all electronic valves hitherto sold under the trade mark OSRAM are now marketed under the trade mark G.E.C.

This change in name, which, it is important to note, applies only to the company's valves, has been considered desirable because of the constantly widening range of the company's electronic devices, some of which have been sold under the trade mark OSRAM and some under G.E.C. Thus a necessary uniformity of trade mark will be achieved. No departure in general design from the familiar blue carton is contemplated other than the change in trade mark.

British General Electric Co. Ltd., the New Zealand Subsidiary of the G.E.C., advise that it will not be possible for the change to be effected immediately as there are still some stocks of valves and cartons bearing the old trade mark.

* * * *

WELLINGTON CITY CORPORATION PLACES LARGE ORDER WITH EUTRON

In a city-wide changeover of water heaters to thermostatic control, Electric Utilities Co. Ltd. re-received the order for three thousand elements with thermostat pockets. The use of these elements made the cost of the changeover considerably less to the Council than would have been the case if the cylinders had had to be removed.

FIRST AGAIN—WITH A ROUND BUILDING

Friday, 6th April, was a red-letter day in the history of record development, when Hollywood's latest architectural phenomenon, the recently completed thirteen-storeyed, two-million dollar Capitol Tower, the world's first circular office building, was dedicated by Capitol Records Inc., with all the usual glamour and excitement of a de luxe film premiere.

Capitol Tower, home of Capitol Records, Hollywood, California, U.S.A.

Giant searchlights radiated welcome to the galaxy of top stars and executives of recordings, motion pictures, radio and television, as they arrived for the grand opening of the unique building.

Prominent also amongst the legion of invited guests were civic dignitaries and press representatives of scores of American and leading newspapers throughout the world.

The ceremony began when Samuel Morse's grand-daughter, Miss Leila Morse, punched a telegraph key which lit a red beacon on the top of the 92 ft. spire of the building. The beacon spelled out "Hollywood" in the international code, paying a mute but glowing tribute to the memory of the inventor of the telegraph.

As they arrived for the opening, the dignitaries were greeted by Glen E. Wallichs, president and directing genius of Capitol Records Inc., Welton Becket, architect, the two executive heads of Electrical and Musical Industries Limited, the giant British Company which owns 96.4 per cent of Capitol, viz.: Messrs J. F. Lockwood, chairman, and A. J. Brown, managing director; also Mr. A. J. Wyness, managing director of His Master's Voice (N.Z.) Ltd., and E.M.I. managing directors from Australia and Brazil.

A guided tour of the building and demonstration of high fidelity recordings was followed by a cocktail party in the course of which each of the guests was presented with "The Capitol Record", a souvenir pressing and brochure in album form featuring the musical history of the rapid rise to eminence of that truly dynamic young organization, Capitol Records Inc.

The fabulous, fantastic growth of Capitol Records Inc., from a dream but fourteen short years ago into the vast, world-wide organization it is today is the success story of Glen E. Wallichs, president.

The culmination of that dream is Capitol Tower, the majestic commercial and cultural centre of one of the world's Big Four record corporations, founded in 1942 by the famous triumvirate, Glen Wallichs, radio engineer and pioneer of the car radio, Johnny Mercer, singer, and Buddy Da Silva, executive producer at Paramount Pictures, and backer of the venture.

Entrance Lobby, Capitol Records.

Rising dramatically above famed "Hollywood and Vine" this new focus of show business activity, Capitol Tower, is not only an imposing landmark, but most importantly perhaps, it is a symbol of exciting growth and progress.

With a diameter of 92 feet the corridorless building rises to the limit height of 150 feet, with the spire towering about 90 feet above its roof. Any increase in the diameter would have necessitated the construction of corridors from the centre to the outside wall in some areas.

The steel-reinforced concrete earthquake-resistant building is round for functional reasons, as well as design. The round structure results in less outside wall surface in proportion to the usable interior areas, thus effecting a great saving in construction cost as well as in air-conditioning operation cost.

On all floors except the first where the floor height varies upon location, the 10 ft. high ceilings are acoustic tiles fastened direct to the concrete slab. On the first floor the ceilings in most areas are suspended.

Glenn E. Wallichs, President, Capitol Records, Inc.

An elaborate and efficient air-conditioning system is controlled by thermostats located throughout the office area. Eighty-five per cent of the gross area of 93,000 square feet is usable. Of this Capitol is occupying the first, second, third, and ninth to the 13th floors.

Particularly interesting is the studio construction, the outside walls being of concrete 10 feet thick. The inside walls, which are completely separate from the outside walls, are built of steel studs, acoustic plaster, and acoustic tile, and stand on a separate floor which does not touch the outside wall.

This inside floor is a three-foot concrete slab resting on a two-foot layer of cork, which in turn rests upon a foundation slab ten feet thick.

Total Capitol sales at the end of the first eighteen months' operations were under one million dollars. In 1955, twelve years later, thanks to the drive, initiative and business acumen of Glen Wallichs, who took over sole control in 1947, they doubled themselves several times.

When, in 1955, E.M.I. Ltd., Hayes, Middlesex, purchased 96.4 per cent of Capitol Records Inc. for 8,500,000 dollars, Wallichs was not only retained as president of the company, but was also elected to the Board of Directors of E.M.I., a fitting promotion for this brilliant 45-year-old giant in the world of recorded music.

* * * *

PLESSEY NUCLEONICS LIMITED

The Plessey Company Limited announce the formation of an associate company, Plessey Nucleonics Limited, to handle their increasing activities in the atomic field.

This new company will be largely concerned with specialized instrumentation and the supply of raw materials, and electronic, mechanical, and hydraulic apparatus associated with nuclear energy projects. It will be particularly interested in the development and production of all forms of control equipment and systems.

A notable example of Plessey achievement in this field is the supplying of specialized detection equipment to Calder Hall, the world's first full-scale nuclear power plant capable of producing electricity economically. The efficiency of this establishment is dependent upon this control installation which was designed and produced in collaboration with the United Kingdom Atomic Energy Authority Industrial Group at Risley, Lancashire.

Directors of Plessey Nucleonics Limited are Mr. A. G. Clark, who is Chairman and Managing Director, Mr. E. J. Earnshaw, Mr. M. W. Clark, and Dr. G. C. Gaut.

* * * *

G.E.C. EXHIBITS MODEL OF ATOMIC POWER STATION AT BRITISH TRADE FAIR IN COPENHAGEN

H.R.H. the Duke of Edinburgh, and Mr Leslie Gamage, vice-chairman and joint managing-director of the General Electric Company Ltd., of England, viewing a model of an atomic power station on the G.E.C. stand at the British Trade Fair in Copenhagen.

For the Technician

SERVICING INSTRUCTIONS FOR THE H.M.V. DOMESTIC WRINGER WASHER SENIOR 35

ACME POWER WRINGER

Parts Numbers:

Part No.	Description	No. Reqd.
P.W. 0	Wringer complete	1
P.W. 1	Frame complete	1
P.W. 2	Press release rail	2
P.W. 4	Press release bracket	1
P.W. 6	Press release bracket spring	1
P.W. 7	Press release link	2
P.W. 8	Press release link rivet	2
P.W. 9	Hand rest	2
P.W. 10 P.W. 11 P.W. 12	Press selector assembly	1
P.W. 13	Top rail with nut	1
P.W. 14	Bow spring	1
P.W. 15	Bow spring clip	1
P.W. 16	Toggle	1
P.W. 17	Toggle retaining clip	1
P.W. 18	Toggle retaining screw L.H.	1
P.W. 19	Toggle retaining screw R.H.	2
P.W. 20	Flume	1
P.W. 21	Flume rubber bracket	1
P.W. 22	Rubber flume tube	1
P.W. 23	Rubber flume tube retaining pin	1
P.W. 24	Flume pivot bolt	1
P.W. 25	Flume pivot bolt nut	1
P.W. 26	Top roll	1
P.W. 27	Top roll bearing	2
P.W. 28	Bottom roll	1
P.W. 29	Bottom roll bearing	2

Service Hints and Service Remedy

1. Top roller not operating. *Remedy*: Lubricate Pressure Bar Screw.

2. Noisy Wooden Bearings Part. No. P.W. 27-29. *Remedy*: Apply Bees wax or tallow. *Caution*: On no account lubricate with oil or grease.

3. Top Rail and Toggle Assembly Part No. P.W. 13-16 will not remain in place under pressure. *Remedy*: As cause is generally a faulty frame in manufacture, the frame should be replaced with a new frame Part No. P.W. 1.

4. Flume P.W. 20 will not react when rollers reversed. *Remedy*: Replace Flume Tube Part No. P.W. 22 as this will be found to be broken. Cause of breakage usually by material getting wound round bottom roller.

5. Should wringer refuse to operate in all positions of control, refer to Wringer Box Service.

WRINGER BOX ASSEMBLY

Parts Numbers:

Part No.	Description	No. Reqd.
514A	Wringer gear box assembly	1/A
51004	Wringer gear box body	1
51005	Wringer gear box cover	2
51006	Pinion spindle	1
51007	Bevel pinion	1
51008	Bevel gear (short boss)	1
51009	Bevel gear (long boss)	1
51011	Wringer drive spindle	1
51012	Sliding dog clutch	1
51015	Case hardened roller	1
51016	Wringer control selector pawl	1
51017	Wringer control selector spring	1
51018	Lock screws	2
51019	Wringer position lock bar	1
51020	Pin for lock	1
51144	Woodruff key	1
51002	Wringer mount studs	2
51003	Nuts for mount studs	4
51010	Wringer drive coupling	1

Service Hints and Service Remedy

1. Machines Serial No. A1001 to Serial No. A4447 which have not had the Wringer box replaced in service can only be serviced by replacing with modified Wringer Box Assembly 514A should trouble arise.

2. As no service problems whatsoever have been experienced with modified Wringer Box Assembly Part No. 514A fitted in all washers commencing Serial No. 4448, should any inspection become necessary service procedure will be as follows:—

(a) Remove Wringer Box Cover Part No. 51005 by inserting screwdriver blade into slot provided in manufacture and lever off.

(b) Unscrew Pinion Part No. 51007 by inserting strong screwdriver through tube in Box Casting Part No. 51004 into pinion drive slot and unscrew in normal fashion.

(c) Unscrew two Lock Screws Part. No. 51018, being careful not to lose Pressure Spring Part No. 51017 and Ball Part No. 51016, and withdraw Operating Lever Part No. 51014 again, taking care not to lose Roller No. 51015.

(d) To withdraw Drive Shaft Part No. 51011 line key in shaft with keyway in Bevel Gear Part No. 51009 and then remove drive shaft.

(e) Reassembly is made by reversing procedure after replacing defective parts. To replace cover Part No. 51005 a sharp blow with a rubber mallet should suffice. Finally seal cover joint with white lead.

BOWL, SHROUD, AND ATTACHED PARTS

Parts Numbers:

Part No.	Description	No. Reqd.
511A	Frame ring assembly	1/A
51021	Wringer gear box bracket	1
51022	Bracket screw (long)	1
51022A	Bracket screw (short)	1
51023	Nuts for bracket screw	2
51024	Finish washers	2
51025	Hose and flex hanger	1
51026	Wringer drive bar	1

51027	Wringer pillar	1
51030	Bowl	1
51031	Shroud	1
51032	Rubber for shroud	1
51038	Legs	4
51039	Castors	4
51040	Bolts	11
51041	Stays	2
51042	Screw for stays	1
51043	Washer	4
51044	Screw to clamp shroud	1
51090/1	Knob (black)	1
51090/2	Knob (red)	1
51091	Rubber bush	2
51127	Cover for worm bush	1
51128	Screw for cover	1
51139	Shroud clip	1
51140	Rubber rings	2
51141	Gasket—wringer bracket	1
51142	Washer	1
51143	Washer	1

Service Hints and Service Remedy

1. To replace Bowl Assembly Part No. 51030.

(a) Disconnect Bowl Outlet Hose Part No. 51100 to pump at pump inlet.

(b) Remove four hexagon head Brass Set Screws Part No. 51046, fixing Agitator Column Assembly Part No. 517A and Bowl Part No. 51030 to main gear box.

(c) Withdraw Agitator Column Assembly Part No. 517A.

(d) Remove Countersunk Screws Part No. 51022 and 51022A attaching Bowl Part No. 51030 to Wringer Bracket Part No. 51021 together with Rubber Packing Part No. 51141, finishing Washers Part No. 51024 and Rubber Washers Part No. 51140.

(e) Replace Bowl Part No. 51030 and reverse procedure for assembly, taking care to seat and seal Agitator Column Assembly Part No. 517A and Bowl properly, using white lead where necessary.

Make sure Gasket Part No. 51082 at base of Agitator Column Assembly is in good condition.

Important

Do not overtighten Hexagon Head Brass Set Screws Part No. 51046 as distortion of Bowl Part No. 51030 may occur with detrimental results.

Vitreous Enamel Bowl Part No. 51030 fitted beginning with Machine No. 4135 and machine model changed from Deluxe Model 51 to Deluxe Model 51E.

(To be continued)

N.Z.A.R.T. NOTES

Our congratulations go to John (Ted) Gawn, ZL2US, on his appointment as Radio Operator to the New Zealand Antarctic Expedition. As the second amateur selected to join this party, we wish Ted every success in this venture. Though not as well known as some in the amateur fraternity, Ted has been "Sparks" on ships since 1941. Stationed at present on the inter-island steamer "Hinemoa", he has served on the "Monowai", "Matua", "Wairuna" and "Maunganui". Forsaking the sea from 1947 to 1952, he was employed at Titahi Bay and Opapa.

From information at present available, it seems likely that the New Zealand party will be permitted to carry out amateur operations, and this provision of a ZL station beyond the boundaries of the Dominion will boost the activities of many amateurs.

Incidentally, "amateur" activity is now in full swing by the American personnel of "Operation Deep Freeze". With KC4USA at Little America operating on single sideband in the twenty-metre band, and KC4USV at McMurdo Sound operating on CW on the same band (approximately 14050 kc/s.), many amateurs now have an opportunity to work in regions hitherto unavailable. As is only fair and natural, most of the time of both stations is devoted to the handling of traffic to the U.S.A. We notice, with regret that many stations are endeavouring to call the South while the latter are still on traffic run, and furthermore that some are even trying to break up the traffic by incessant calls when the Antarctic stations are actually on the air. Fortunately, the offenders are not New Zealand stations, and we trust this will never be so. In due course, amateur working will develop on a world-wide basis and the Antarctic stations will be operative for some considerable time yet.

From KC4USV (McMurdo), we learn that CW will be the order of the day for some time. However, telephony (probably SSBSC) will be undertaken early next year.

Operating at the New Zealand Industries Fair, the Christchurch Branch is again to the fore. In general, operating conditions seem better through the relay from the Fair on 80 and 160 metres and the receipt of inward traffic on a 160 or 2-metre link from the relay stations. Public interest in the exhibition has been greatly stimulated by the availability of all band operation. This year the administration and operation of the station has been undertaken by some of the younger members of the Branch and the unqualified success of the 1956 effort is due entirely to their stalwart work.

By the time these notes are published the 1956 Conference at Auckland will be a thing of the past. The programme promises an interesting time to all who attend.

Though special arrangements have been made for the entertainment of the ladies, the days of the "Radio Widow" are fast fading, and it has been well proved that there is a definite place for the womenfolk in our hobby.

* * * *

NOTES FROM THE NEW ZEALAND ELECTRONICS INSTITUTE (INC.)

(Supplied by the Secretary, N.Z.E.I. Inc., P.O. Box 546, Dunedin, to whom all inquiries should be addressed).

The following three new members were admitted to the Institute recently:

Graduate: H. W. Read, c/o 2YA, The Terrace, Wellington.

Associate Members: E. Davenport, 2723 Eastern Avenue, British Columbia, Canada; C. L. Parry, P.O. Box 1596, Christchurch.

Transfer from Associate to Graduate: P. J. C. Dalliessi, 47 Fingall Street, South Dunedin.

A Novel Magic-eye Indicator Circuit

(Continued from page 27)

potential is applied to the control grid, the potential of the triode plate becomes more positive, increasing the current through the indicator section as the shadow angle decreases. There is a net increase of current in the common cathode resistor, which causes the cathode to become more positive with respect to earth. This has the same effect on the amplifier section as a further increase in the negative input voltage, so that there is positive feedback present. It is not possible to give the exact value that should be used in a given case, because this will depend on circumstances. The value required is quite small, however—usually not more than one or two hundred ohms. As with all positive feedback arrangements, too much spoils the flavour, and the situation can be reached whereby a very small input voltage will cause the eye to close completely, giving no discrimination at all. In the circuit of Fig. 1, the cathode resistor has to be bypassed on account of the 50-cycle switching voltage, but for increasing the sensitivity in a radio receiver, for example, no bypassing will be needed, nor would it have any effect on the positive feedback, because the latter is brought about by the D.C. coupling between the two sections of the magic eye. Some types of magic eye tube will be more sensitive to this form of sensitivity enhancement, simply because their target current varies more. Perhaps the best type to use where extra sensitivity is wanted is the 6E5, which does not have a remote-cut-off triode section. However, with the 6U5 and other types which prevent a "cross-eyed" indication by having a remote-cut-off triode section, the increase in sensitivity will be greatest at small signal levels, just where it is wanted. The feedback resistor, when properly adjusted will be very effective in making a magic eye tube respond to weak short-wave signals which normally, would hardly flicker the shadow.

Philips Experimenter

(Continued from page 29)

The recommendations given above apply in cases where normal or nearly normal tube life is expected. Under laboratory conditions, it is often possible to use considerably higher ratings than have been recommended, particularly if reduced life is unimportant.

When tubes are being run up to voltage higher than the normal for their type, for the first time, occasional internal flash-overs may be expected. In order to allow for this, the associated equipment should be designed in such a way that high surge currents, due to such flash-overs, and the resulting high-voltage transients, will not be detrimental to the equipment. This kind of transient often has components at very high frequencies, so that protection can be conferred by taking the same steps as for suppressing V.H.F. parasitics. Bypass condensers should obviously be of high voltage-rating, and small chokes may be needed in some leads to prevent V.H.F. voltages of high value from being built up across the leads. Spark-gaps can also be used as protective devices. Added protection can be had by ensuring that the regulation of the power supply is poor.

Gramophone Amplifiers

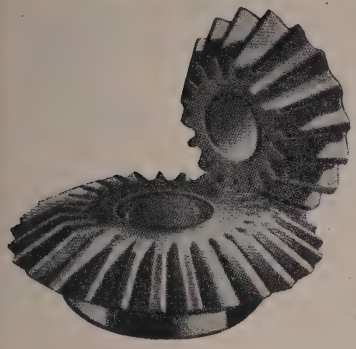
(Continued from page 26)

extreme upper end that stylus wear will become apparent if the pickup is not a new one, as the high-frequency response is more affected by this than are other frequencies.

If one has access to an audio oscillator instead of a test record, the procedure is the same, except that the oscillator should be connected either directly to the grid of the EF86, or through a large blocking condenser to the plate of the same tube. Alternatively, the coupling condenser can be temporarily disconnected from the EF86 plate, and the oscillator connected to it. If the oscillator is fed into the grid of the EF86, care must be taken to see that the valve is not overloaded, as if it were, there would be a marked effect on the measured frequency response.

B.B.

TUFNOL



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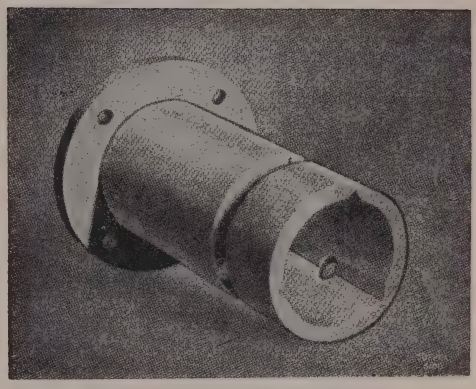

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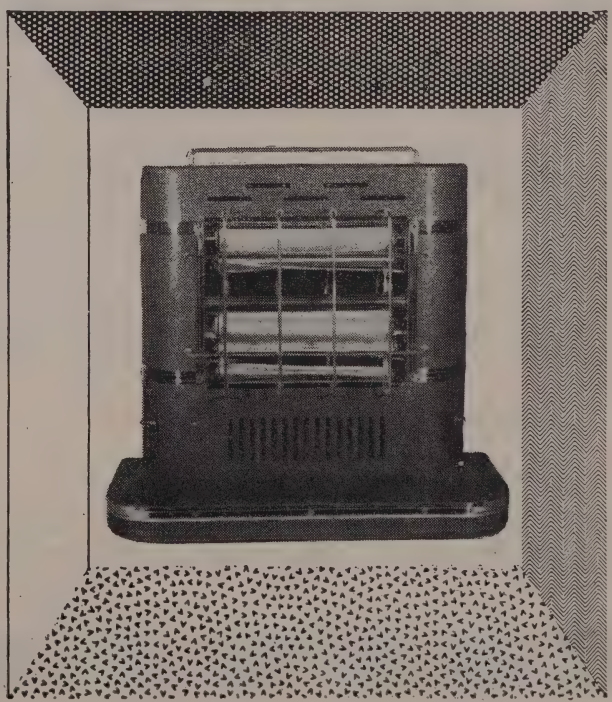

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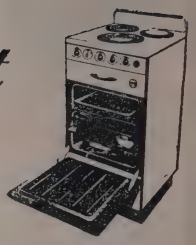

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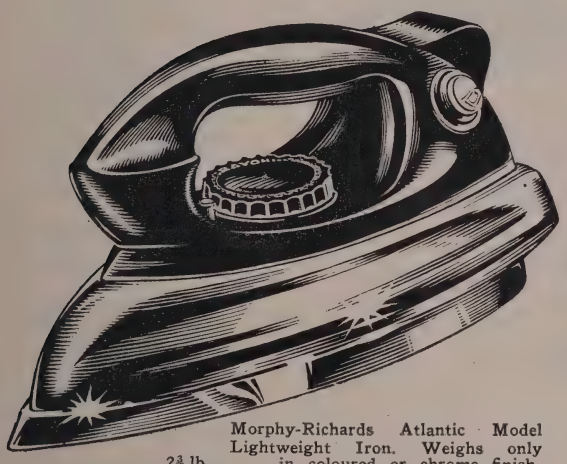

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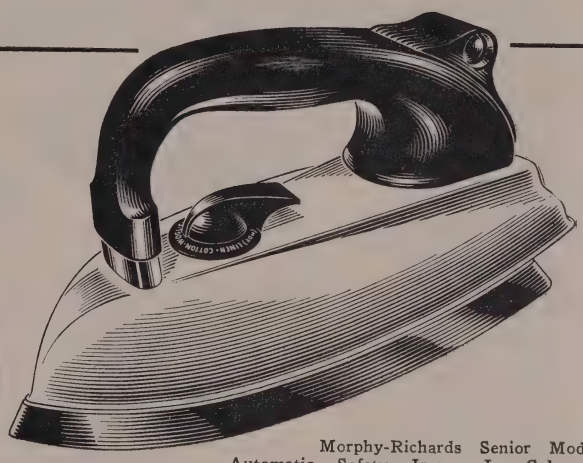

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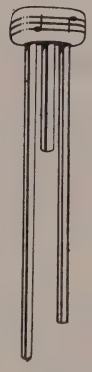

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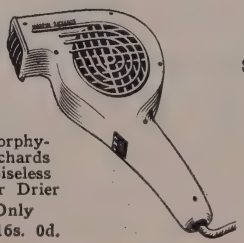

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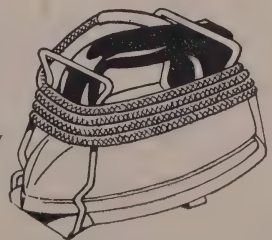

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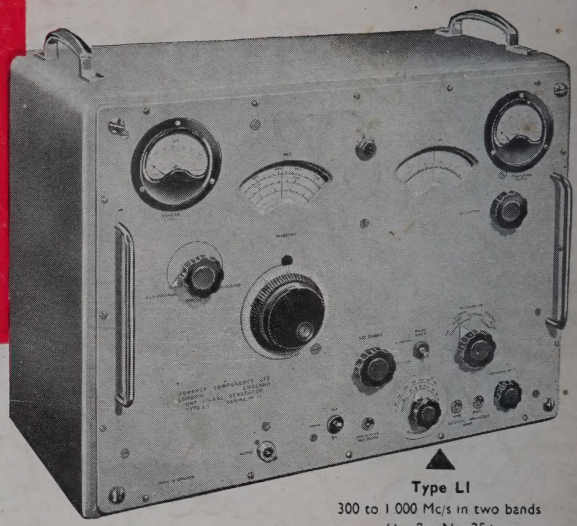
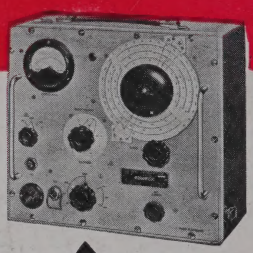
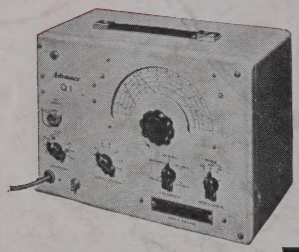


Type L1
300 to 1 000 Mc/s in two bands
(Leaflet No. 25)



Type D1/D
10 to 300 Mc/s in six bands
(Leaflet No. 26)



Type Q1
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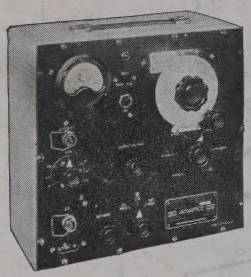
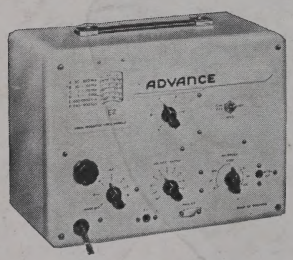


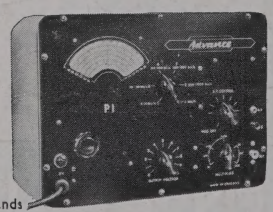
Type B4
Model A, 100 kc/s to 80 Mc/s in six bands
Model B, 30 kc/s to 30 Mc/s in six bands
(Leaflet No. 11)



Type E2
100 kc/s to 100 Mc/s in six bands
(Leaflet No. 14)

Type H1
15 c/s to 50,000 c/s in three bands
(Leaflet No. 16)

Type J1
15 c/s to 50,000 c/s in three bands
(Leaflet No. 29)



Type P1
100 kc/s to 100 Mc/s in six bands
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